THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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INSTITUTIONS AND THEIR PROCEEDINGS.

NEVER before within our recollection—and that covers no brief period—has the month of June been so marked by the activities of engineering societies closely related to the electrical industries as the current month promises to be. To-day the Western Centre of the Institution of Electrical Engineers has embarked upon its excursion to Plymouth—a holiday occasion, for it will be marred (if that is the right word) by no technical programme. That will scarcely have passed into history when the summer meeting of the Institution as a whole in the North-West commences on Tuesday next—a meeting which, in strong contrast to the former, will offer crowded hours of technical sight-seeing, as well as junketing and other forms of recreation; more than 400 members and ladies will take part in this notable gathering, which will occupy the whole of four busy days.

In the following week the Institute of Transport will hold a congress at Sheffield, when several papers of electrical interest will be read, and immediately afterwards there will be a recrudescence of electrical ebullition, this time on the East Coast, when the annual convention of the Incorporated Municipal Electrical Association will take place at Scarborough, which will do deputy for Grimsby (happily the idea which was once put forward, that the I.M.E.A. should hold its convention on board ship, has not been received with favour); after their strenuous time in the Midlands last year, the members will be glad to face a programme which calls for a minimum of exertion, and, whilst including a fair proportion of "shop," affords ample opportunity for social intercourse and restful recreation. During the same week the Tramways and Light Railways Association will meet in conference at Swansea, and the I.E.E. conversazione on June 28th will complete the programme for the month.

Whether it be held fortunate or otherwise that these five important functions should be held within the space of three weeks depends upon the point of view; certainly no one would wish to attend them all! But those who are entitled to attend more than one will probably find it difficult to do so, and in some cases impossible.

We have not space available to comment further on the programmes for these events, but the occasion seems appropriate for us to draw attention once more to the proposal that we have put forward from time to time—that a great engineering convention should be held, in London, in which all these societies and others also could take part. Whether this should be an annual event or not need not now be discussed, but certainly there can be no question but that the first such convention should be held next year in conjunction with the British Empire Exhibition. In our issue of March 23rd last, referring to the World Power Conference which it is proposed to hold in connection with the Exhibition, we suggested that London might next year be made the centre for the annual meetings of the various engineering, manufacturing, and contracting associations, and that a programme of special events should be drawn up. The time remaining will barely allow of satisfactory arrangements being completed, and therefore, if our proposals meet with the approval of our readers, they should lose not a moment in expressing their views on the matter in the proper quarters.

Every year such conventions are held in the United States, affording admirable opportunities for old

friends to forgather and for important questions to be discussed from various points of view; and no doubt they go far towards engendering in the public mind a better realisation of the magnitude and importance of the engineering profession and thereby improving the status of engineers—a matter of which so much is said, but to further which so little is done. If engineers really wish to attain their proper standing in the public eye, they must see to it that the public has something to look at that it can understand.

The Exhibitors at Next Year's Exhibition.

WE publish in this issue the latest official information regarding the booking of floor space at the British Empire Exhibition by companies and firms connected with the electrical, engineering, and shipbuilding industries. In devoting so much space to this matter at this particular time we have several objects in view. First and foremost is the desire to demonstrate by names of firms how large a number of British manufacturers have definitely made up their minds to contribute their quota toward rendering the display effective; secondly, to show by the large space-booking by the comparatively small number of firms in what we may call the B.E.A.M.A. section that a number of such exhibitors intend to make large and imposing demonstrations; thirdly, to indicate the many electrical omissions, of both B.E.A.M.A. and non-B.E.A.M.A. firms, and perhaps more particularly those of certain classes, such as makers of domestic electrical apparatus and appliances. Possibly the publication of this information will assist associated and non-associated firms who have not yet come to a decision to exhibit, and have not definitely resolved to refrain from doing so, to make up their minds whether their own interests as well as those of the industry do not call for their co-operation. We are aware of some of the difficulties, and are not unmindful of some of the objections, but these are present to the minds of those who have considered the matter, and they, after resolving upon a refraining attitude, will be unlikely to lay the blame at anybody else's door if they experience disappointment later. We appeal to-day to those who have deferred serious consideration of the matter because they have felt that there was plenty of time. In less than a year the Exhibition will be in full swing and the traffic from Overseas to Wembley will be heavy. We have little doubt that the unbooked space will have been allocated by the end of the present year; the sooner the actual space-letting part of the business can be completed the better. There will be a vast amount of other work for the authorities to do so that everything may be in complete condition by the opening date; but exhibitors, too, will require considerable time for the preparation of their display manufactures—there will be no room for anything of a makeshift character—and those who defer their decision regarding space too long may be too hurried in their practical preparations at a later stage.

In publishing the lists and plans now, we have one other important object in view. We are looking forward to meeting next year hundreds of electrical and engineering men of eminence and practical authority from countries overseas. Many of these have already made their plans to visit these islands during the run of the Wembley Exhibition. They will be able to judge from what we now publish how fine a collection of British engineering manufactures will be brought together "under one roof" so to speak. In their ordinary visits home they journey from centre to centre seeing a few works and a few power stations. This time they will be able to see the cream of British manufacturing all brought together, with representatives of numerous businesses, and a finely-equipped power station and system, as well as many things new which will emerge from the brains and work of our engineers during the next twelve months.

We appeal to all of our readers overseas who have not yet made plans for taking the journey to England, to study the forecast contained in our article and to determine early upon the right course. We shall be grateful to all of our oversea readers, whether in the Colonies and Dependencies or in foreign countries, if they will advise the ELECTRICAL REVIEW of their intentions. Though the Exhibition is a British one, and all manufactures shown must be British, visitors from every nationality under the sun will find a most cordial welcome awaiting them at these offices, at the Exhibition itself, and in the various works and electrical systems of the United Kingdom, where British activity and capacity can be judged.

The Earthed Return.

IN our last issue we gave some particulars of the use of lead-covered underground cable for the distribution of electricity in rural areas, by the Hydro-Electric Power Commission of Ontario; the cable, of which 150 miles has been laid, is *unarmoured* and is laid directly in the ground without protection, and the lead sheathing is used as the return conductor. We learn with interest from Mr. A. Hugh Seabrook, of Messrs. Sir Charles Bright & Partners, Ltd., that his firm is adopting a similar plan in connection with the distributing system of the Swanage Electricity Co., Ltd. The high-pressure single cables, working at 2,500 volts a.c., and the low-pressure cables, at 240 volts, will be "single-pole" unarmoured, with the outer conductor (*i.e.*, the lead sheathing) earthed. A proportion of concentric cable is also scheduled in the specification for use in the towns and villages, but with this we are not concerned.

Why is the earthed-return system so little used in this country nowadays? We remember a time when concentric earthed-return indoor wiring was strongly advocated, and several ingenious systems were elaborated, some of which are still on the market. The Institution Wiring Rules offer no obstacle to the adoption of earthed concentric wiring, and of course the earthed-return system is very widely used on board ship, but on land it is necessarily restricted to isolated installations unless a double-wound transformer is provided.

The more important matter, however, is the use of the earthed return for rural transmission lines, whether overhead or underground. In the latter case, assuming that all the current returns by the lead sheathing, the drop of pressure therein will be about the same as in the copper conductor in the case of small cables of ordinary construction (say, 0.01 sq. in.), but in larger sizes it will be much greater (about five times in the case of a 0.1 sq. in. cable). Hence, as the thickness of the sheathing of the larger cables could not economically be increased sufficiently to give a reasonable drop, either it must be reinforced with a copper conductor or steps must be taken to ensure that the conductance of the earth is utilised, by providing earth plates at suitable points. Some years ago Mr. J. S. Highfield, when laying out the high-pressure direct-current system by which supply is given from Willesden to Southall in the western area of the Metropolitan Electric Supply Co., made an elaborate series of experiments on the use of the earth as a return conductor, with a view to employing it as a stand-by in the event of breakdown of a cable; the results were included in a paper read before the Institution of Electrical Engineers, and recorded in our issue of June 21st, 1912, and they clearly show that an earth resistance as low as one ohm can be readily obtained. The only questions remaining to be considered are those of electrolysis and interference with telegraphs. With alternating current the former is practically negligible; with regard to the latter, in rural districts the telegraph and telephone lines are not numerous, but the possible effect upon them must be considered. However, Mr. Highfield stated (*loc. cit.*) that Post Office engineers had found a potential difference of only 1.4 volts between Southall and Willesden, a distance of

seven miles, when a direct current of 90 amperes was flowing. Moreover, experience gained with the use of the earthed return for tramways, and in some cases for railways, during the last quarter of a century, with a direct-current drop in the earth limited by the Board of Trade regulations to a maximum of seven volts, has abundantly proved that where suitable precautions are observed neither electrolysis nor interference with telegraphs need be feared.

There appears therefore to be no good reason to forgo the use of the earth as a conductor under the conditions here referred to, and obviously great economies can be effected thereby; for one thing, there is only one insulated conductor, so that failures should be minimised —the earth won't break down! The cable itself costs less, joints are more easily made and more reliable, the cost of services is reduced, and the liability to interruption of supply is diminished. By dispensing with the use of armour a further economy is effected, amounting to no less than 40 per cent. in the case of the smaller cables; the value of armouring as a protection is highly problematical, and one important undertaking has used plain lead-sheathed cable for years, with satisfactory results. The attitude of the Electricity Commissioners and the Postmaster-General towards the method must be taken into account, but whilst the Board of Trade would probably have demurred, in these days such questions are decided by engineers on technical and not on political grounds. We think, therefore, that the lead which Mr. Seabrook has given in this country should be closely watched with a view to following his example in other rural districts.

Incidentally, Mr. Seabrook is specifying for single-phase integrating ampere-hour meters for Swanage—in accordance with the views which he expressed in our "Correspondence" columns not long ago.

Candidates' Testimonials.

It is unfortunately necessary, owing to certain discreditable occurrences, to advise those whose duty it is to consider applications received for electrical situations vacant, to investigate the accuracy of testimonials where only copies of such, and not originals, are submitted. It may be excusable for a man to have an exaggerated opinion of his qualifications—especially when in search of a job, but when men who are in employment already lay false claim to the possession of testimonials regarding their training and experience on the chance that they will not be investigated, one can but describe them as either fools or knaves. Without entering into the details that have come to our knowledge of the way in which attempts were made to secure a certain municipal electric supply vacancy, we may say that those who try to obtain positions by gross misrepresentation are playing a dangerous game and the penalty for their wrong-doing should be heavy. Perhaps it may be thought unnecessary for us to issue this caution, as most electric supply engineers and committees make a regular practice of investigating the accuracy of statements bearing on the suitability of a candidate. May be it is so, but appointments sometimes have to be made in a hurry, and if caution be absent, they may prove to be *dis*-appointments.

The Progress of France.

France has truly profited by the lessons of the war. She soon learned that Germany would only meet her obligations in so far as the Allies compelled her to do so. She lost no time before she set systematically to work on making good the evil wrought by the enemy in the battle zones. When German money was not forthcoming to meet the necessary expenditure, she arranged to accept a partial equivalent in goods, and when both cash and kind were in default, she went into the Ruhr to fetch what was justly hers. Meanwhile, the progress she has made in restoring her farms, factories and mines has been wonderful. It is described in the interesting report by H.M. Commercial Counsellor in Paris, which we review on another page. Though France has been criticised on account of the lavish expenditure she has made of borrowed money, she has not resorted to undue inflation, and has been most successful in raising internal loans, with the result that her credit is withstanding well the failure of her expectations of German payments. The money has been well laid out in reproductive work. The technical equipment of her industries has been thoroughly modernised, and she has gained much manufacturing experience that she did not possess before the war. Thus we see a France with a very greatly increasing capacity to administer to the future needs of the world's markets, although at present her own requirements at home are not fully satisfied, whilst international demand is difficult to translate into actual business because the necessary funds are lacking. Close by there is Germany with a marvellously enhanced manufacturing power and a saturated home market that has bought all it can afford to buy. And again, across the Channel, Great Britain stands with her industrial strength only partly utilised and in considerable need of oversea orders. It seems evident that competition for foreign contracts will grow fiercer as time goes on, and therefore it behoves the British manufacturer to examine how he can best turn to account such advantages as he possesses, and at the same time see whether he cannot benefit himself by imitating some of the methods of his rivals. Continental industry apparently stands to benefit by the high degree of organisation to which it has attained. Great Britain's metallurgical and engineering industries still lack anything approaching a central selling association for export trade such as has enabled the United States iron and steel industry to effect wonderful economy in its foreign commerce, and such as both the French and German engineering concerns with their respective "communities of interest" are in a splendid position to establish and maintain. Our producers need to reduce their manufacturing as well as their selling costs. Their European competitors have done much by the adoption of methods of fuel economy and by the utilisation of electric power. There is little doubt that were it not for our notorious extravagance in the use of coal we could substantially reduce the price of our finished goods. On the other hand, we probably possess a strong card in our capacity to finance large foreign contracts. This, it is true, is not so great as that of the United States, but it is superior to French and German capacity. Numbers of engineering and constructional schemes abroad are held up by lack of funds. It is believed in some directions that Great Britain might profit more widely by this financial advantage if she were to add to it by coming to a closer understanding with United States industry.

The Wimbledon Affair.

From the daily Press we learn that Mr. S. J. Jenkins, an employé for 23 years of the electricity department of the Wimbledon Corporation, who gave evidence on behalf of Mr. H. Tomlinson Lee in his recent action against Alderman Peel, has been dismissed. We understand that, as in Mr. Lee's case, no ground for this action has been stated. It is possible that there is no connection between the two happenings; it is, however, as the *Wimbledon Borough News* remarks, indeed unfortunate, if such is the case, that the Council should have chosen this moment to dismiss an old employé, and we are not surprised to hear that the town is in a commotion. A petition has been presented to the Mayor, calling for an inquiry and the reinstatement of Mr. Jenkins.

We trust that a satisfactory explanation will be forthcoming; for if it were the case that Mr. Jenkins had been the victim of spite and penalised for his testimony in a court of justice, the shame and disgrace incurred should brand the town for years to come as no place for honest men to dwell in.

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THE BRITISH EMPIRE EXHIBITION, 1924.

The Electrical and Engineering Exhibitors.

By courtesy of the British Electrical and Allied Manufacturers' Association and the British Engineers' Association we are able to publish below alphabetical lists of the firms which have definitely booked space in the sections for which these two associations are responsible at the great Exhibition which will be in progress at Wembley less than a year from now.

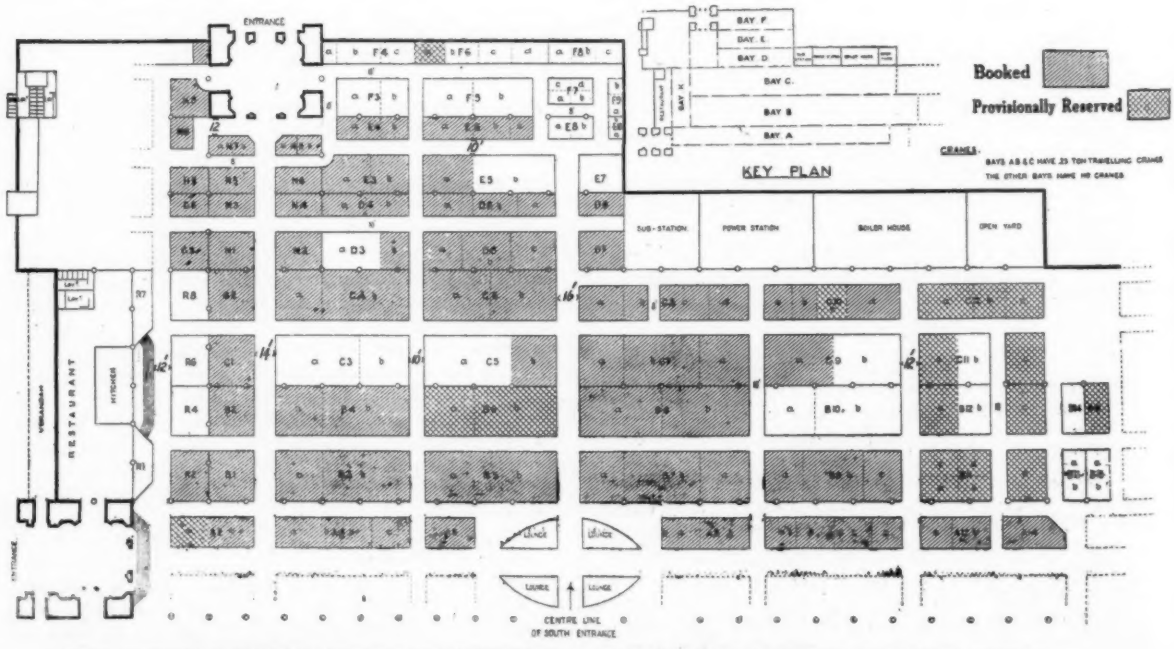
The B.E.A.M.A. list includes exhibitors in the Electrical and Allied Engineering Section, and is dated April, 1923. The British Engineers' Association table indicates the exhibitors' list right up to date for the Shipbuilding, Marine, Mechanical, and General Engineering Section.

These lists, together with the floor space plans which accompany them, will convey some idea of the progress that has been made with the organisation of the biggest show of British engineering machinery and equipment that has ever been planned. We refer further to the subject in our "Leaderette" pages.

Table I.—List of Exhibitors in the Electrical and Allied Engineering Section.

Adamson, Daniel, & Co., Ltd.
Allen West & Co., Ltd.
Babcock & Wilcox, Ltd.
Belliss & Morcom, Ltd.
British Electric Transformer Co., Ltd.
British Insulated & Helsby Cables, Ltd.
British Thomson-Houston Co., Ltd.
Brook, Hirst & Co., Ltd.
Brook, E., Ltd.
Browett, Lindley & Co., Ltd.
Brown, S. G., Ltd.
Brush Electrical Engineering Co, Ltd.
Burndept, Ltd.
Cable Makers' Association, comprising:—
- British Insulated & Helsby Cables, Ltd.
- Callender's Cable & Construction Co., Ltd.
- Glover, W. T., & Co., Ltd.
- Henley's, W. T., Telegraph Works Co., Ltd.
- Johnson & Phillips, Ltd.
- Liverpool Electric Cable Co., Ltd.
- London Electric Wire Co. and Smiths, Ltd.
- Siemens Bros. & Co., Ltd.
- Union Cable Co., Ltd.
- Western Electric Co., Ltd.

Callender's Cable & Construction Co., Ltd.
Chloride Electrical Storage Co., Ltd.
Crompton & Co., Ltd.
Crypto Electrical Co., Ltd.
Davenport Engineering Co., Ltd.
D. P. Battery Co., Ltd.
Docker Bros., Ltd.
Dugdill, John, & Co.
Eastern Telegraph Co., Ltd.
Ebonestos Insulators Co., Ltd.
Edison Swan Electric Co., Ltd.
Electric Control, Ltd.
ELECTRICAL REVIEW
Electrical Times
Electromotors, Ltd.
Elliott Bros. (London), Ltd.
Ellison, George
English Electric Co., Ltd.
Erskine, Heap & Co., Ltd.
Ever Ready Co. (G. B.), Ltd.
Everett, Edgcumbe & Co., Ltd.
Ferguson, Pailin, Ltd.
Fraser & Chalmers Engineering Works
Fuller's United Electric Works, Ltd.
General Electric Co., Ltd.
Glover, W. T., & Co., Ltd.
Hart Accumulator Co., Ltd.
Henley's, W. T., Telegraph Works Co., Ltd.
Hick, Hargreaves & Co., Ltd.
Holden & Brooke, Ltd.
Ioco Rubber & Waterproofing Co., Ltd.
Johnson & Phillips, Ltd.
Lancashire Dynamo and Motor Co., Ltd.
Liverpool Electric Cable Co., Ltd.
London Electric Wire Co. and Smiths, Ltd.
Magnet Engineering Co.
Marconi's Wireless Telegraph Co., Ltd.
Mather & Platt, Ltd.
McMichael, L., Ltd.
Metropolitan-Vickers Electrical Co., Ltd.
Micanite & Insulators Co., Ltd.
Mirrlees, Bickerton & Day, Ltd.
Mirrlees, Watson Co., Ltd.
Nalder Bros. & Thompson, Ltd.
Park Royal Engineering Works, Ltd.
Parsons, C. A., & Co., Ltd.
Power Plant Co., Ltd.
Pritchett & Gold & Electrical Power Storage Co., Ltd.
Relay Automatic Telephone Co., Ltd.
Reyrolle, A., & Co., Ltd.
Royce, Ltd.
Siemens Bros. & Co., Ltd.
Silver Replating Powder Co.
Sterling Telephone & Electric Co., Ltd.
Sutcliffe (of Crumpsall), Ltd.
Switchgear & Cowans, Ltd.
Telephone Manufacturing Co., Ltd.
Thomas, Bertram
Thompson, John, Water Tube Boilers, Ltd.
Tudor Accumulator Co., Ltd.
Twiss Electric Transmission, Ltd.
Union Cable Co., Ltd.
Watford Electric & Manufacturing Co., Ltd.
Western Electric Co., Ltd.
Whipp & Bourne, Ltd.



PLAN SHOWING THE STANDS ACTUALLY AND PROVISIONALLY BOOKED IN THE ELECTRICAL AND ALLIED SECTION.

Table II.—List of Exhibitors in the Shipbuilding, Marine, Mechanical, and General Engineering Section.

Accles & Pollock, Ltd.
Aerograph Co., Ltd.
Allen, Edgar, & Co., Ltd.
Allen, Everitt & Sons, Ltd.
Allen, W. H., & Co., Ltd.
Angular Hole Drilling and Manufacturing Co., Ltd.
Armstrong Whitworth, Sir W. G., & Co., Ltd.
Aster Engineering Co. (1913), Ltd.
Attwater & Sons
Avery, W. & T., Ltd.
Bailey, Sir W. H., & Co., Ltd.
Baldwins, Ltd.
Balfour, Arthur, & Co., Ltd.
Barron, W. S., & Son
Beakbane, Henry
Beardmore & Co., Ltd.
Beldam Packing & Rubber Co.
Blakeborough, J., & Sons, Ltd.
Bolckow, Vaughan & Co., Ltd.
Braby, F., & Co., Ltd.
Braime, T. F., & Co., Ltd.
Braithwaite & Co., Ltd.
Brass & Copper Tube Association
Brass Wire Association
Brazed Brass Tube Association
British Mannesman Tube Co.
British Oxygen Co., Ltd.
Broadbent, Thos., & Sons, Ltd.
Brockhouse, J., & Co., Ltd.
Butler, J., & Co., Ltd.
Caledonia Wire Rope Co.
Cargo Fleet Iron Co., Ltd.
Carmichael, James, & Co., Ltd.
Castlecary Fireclay Co., Ltd.
Chesterfield Tube Co., Ltd.
Cochrane & Co., Ltd.
Cold Rolled Brass Association
Colville, David, & Sons, Ltd.
Cradock, G., & Co., Ltd.
Culley Expressors, Ltd.
Daniels, T. H. & J., Ltd.
Darlington Rolling Mill Co., Ltd.
Davidson & Co., Ltd.
Davis & Timmins, Ltd.
Day, Summers & Co., Ltd.
Delta Metal Co., Ltd.
Densham, H., & Son, Ltd.
Dewrance & Co.
Diamond Coal Cutter Co.
Dominion Machinery Co.
Dorman, Long & Co., Ltd.
Drewry Car Co., Ltd.
Drysdale & Co., Ltd.
Engineer Newspaper.
Engineering Publications Ltd.
Eston Sheet & Galvanising Co., Ltd.
Etchells, Congdon & Muir, Ltd.
Firth, Thos., & Sons, Ltd.
Fleming, Birkby & Goodall, Ltd.
Fleming & Ferguson, Ltd.
Fowler, John, & Co. (Leeds), Ltd.
Frys (London), Ltd.
Gandy Belt Manufacturing Co.
Gear, H. R., Co., Ltd.
Glenboig Union Fireclay Co.
Glenfield & Kennedy, Ltd.
Gloucester Railway Carriage and Wagon Co., Ltd.
Gordon, James, & Co., Ltd.
Green, E., & Sons, Ltd.
Greenwood & Batley, Ltd.
Gresham & Craven, Ltd.
Guest & Chrimes, Ltd.
Guest, Keen & Nettlefolds, Ltd., John Lysaght, Ltd., Bayliss, Jones & Bayliss, Ltd., John Garrington and Sons, Ltd.
GwynnesEngineeringCo.,Ltd.
Hadfields, Ltd.
Hall, Alexander, & Co., Ltd.
Hall, J. & E., Ltd.
Hall, Robert, & Sons (Bury), Ltd.
Hardacre, John T., Ltd.
Harling, W. H.
Harrison & Camm, Ltd.
Harvey, G. A., & Co., Ltd.
Haslam Foundry & Engineering Co., Ltd.
Hawthorn Leslie, R. & W., and Co., Ltd.
Hay Maryon & Co., Ltd.
Hayward-Tyler & Co., Ltd.
Heatly-Gresham Engineering Co., Ltd.
Heinke, C. E., & Co., Ltd.
Hendry, James, Ltd.
Heywood, S. H., & Co., Ltd.
Hill, Richard, & Co., Ltd.
Hingley, N., & Sons, Ltd.
Hodgkinson, James (Salford), Ltd.
Holdsworth & Sons, Ltd.
Holman Bros., Ltd.
Honeywill Bros., Ltd.
Howden, James, & Co., Ltd.
Hughes & Lancaster, Ltd.
Hurll (Peter & Mark), Ltd.
Jessop, Wm., & Sons, Ltd.
Johnson, Richard, & Nephew, Ltd.
Keith, James, & Blackman Co., Ltd.
Kennedy, Herbert, & Co., Ltd.
Kenrick, Archibald, & Sons, Ltd.
Kent, George, Ltd.
Kirkstall Forge Co.
Kitson & Co., Ltd.
Kitson Engineering Co.
Kryn & Lahy Metal Works, Ltd.
Lacy, Hulbert & Co., Ltd.
Laing, Sir James, & Sons, Ltd.
Lancaster & Tonge, Ltd.
Lea Recorders Co., Ltd.
Lobnitz & Co., Ltd.
Locomotive Publishing Co.
Loveridge, Ltd.
Liverpool Engineering and Condenser Co., Ltd.
Marryat & Scott, Ltd.
Marx, J. & E.
Maurice Bart Bloom
Mavor & Coulson, Ltd.
McGeoch, Wm., & Co., Ltd.
Mitchell Conveyor & Transporter Co., Ltd.
Mitchell, P. D., Ltd.
Mond Nickel Co., Ltd.
Monninger, C. D., Ltd.
Morgan Crucible Co., Ltd.
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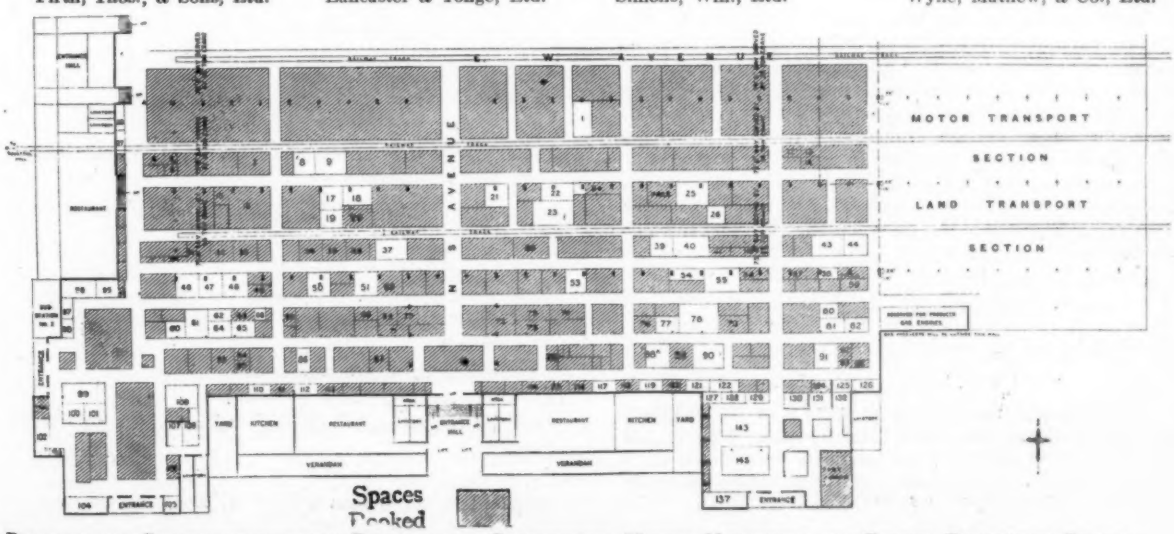
Petters, Ltd.
Pickersgill, Wm., & Sons, Ltd.
Pitter Gauge & Precision Tool Co., Ltd.
Platt, J. W. & H.
Port Talbot Steel Co.
Pott Cassels & Williamson
Priestman Bros.
Priestman Bros., Ltd.
Pulsometer Engineering Co., Ltd.
Redlers, Ltd.
Redpath, Brown & Co.
Reid, McFarlane & Co., Ltd.
Rhodes, Joseph, & Son, Ltd.
Rhondda Engineering and Mining Co., Ltd.
Roadless Traction Co., Ltd.
Robb, Henry, Ltd.
Roberts, Charles, & Co., Ltd.
Robey & Co., Ltd.
Robinson, Thos., & Sons Ltd.
Rockman, J.
Rubery Owen & Co.
Ruston & Hornsby, Ltd.
Sanderson Bros. & Newbould, Ltd.
Saunders, S. E., Ltd.
"Sentinel" Wagon Works (1920), Ltd.
Serck Radiators, Ltd., and Serck Tubes, Ltd.
Sheepbridge Stokes Centrifugal Castings Co., Ltd.
Simon, Henry, Ltd.
Simons, Wm., Ltd.
Small & Parkes, Ltd.
Smith's Dock Co., Ltd.
South Durham Steel & Iron Co., Ltd.
Spear & Jackson, Ltd.
Standard Machine Works, Ltd.
Staveley Coal & Iron Co., Ltd.
Sterne, L., & Co., Ltd.
Sterns, Ltd.
Steven, A. & P., Ltd.
Stewarts & Lloyds, Ltd.
Stoker, A. W.
Stuart Turner, Ltd.
Summerson, Thos., & Sons, Ltd.
Swan, Hunter & Wigham Richardson, Ltd.
North British Diesel Engine Works (1922), Ltd., M. W. Swinburn & Sons (1920), Ltd., Harfield and Co., Ltd., Archibald Watson & Co., Ltd., Barclay Curle & Co., Ltd., North of Ireland Shipbuilding Co., Ltd., Philip & Son, Ltd.
Tangyes, Ltd.
Taylor & Challen, Ltd.
Thompson Bros. (Bilston), Ltd.
Thompson, Joseph L., and Sons, Ltd.
Thornycroft, John I., & Co., Ltd.
Tullis, John, & Son, Ltd.
Turner Bros. Asbestos Co., Ltd.
Tweedales & Smalley (1920), Ltd.
Vacuum Brake Co., Ltd.
Vickers, Ltd.
Robert Boby, Ltd., James Booth & Co. (1915), Ltd., British Lighting & Ignition Co., Ltd., British Refrigerating Co., Ltd., Cooke, Troughton and Simms, Ltd., Electric and Ordnance Accessories Co., Ltd., Metropolitan Carriage, Wagon & Finance Co., Ltd., Patent Shaft and Axletree Co., Ltd., Taylor Bros. & Co., Ltd., Variable Speed Gear, Ltd.
Vidal Engineering Co., Ltd.
Walker, Wm., & Son, Ltd.
Wallis & Steevens, Ltd.
Watson Laidlaw & Co., Ltd.
Weir, G. & J., Ltd.
Welin Davit Engineering Co., Ltd.
Wellman Smith Owen Engineering Corp., Ltd.
White, Thos., & Sons, Ltd.
Wilkins Wire & Wire Rope Co., Ltd.
Wilson Bros. Bobbin Co., Ltd.
Wright, John & Edwin, Ltd.
Wylie, Mathew, & Co., Ltd.



Plan showing Spaces that have been Booked in the Shipbuilding, Marine, Mechanical, and General Engineering Section.

THE APPROXIMATE INTEGRATION OF REACTIVE POWER IN THREE-PHASE CIRCUITS.

By G. W. STUBBINGS, A.M.I.E.E., A.Inst.P.

Methods of charging for electric power supplies, designed to induce consumers to install power-factor correcting devices, frequently call for the determination of the wattless kVAh in the supply. Although the exact method of determining this quantity is quite simple, indirect and approximate methods have been devised, and are in use. The object of this paper is briefly to consider such approximate methods, with a view to determining the errors likely to occur in such circumstances as may be met with in actual practice.

The Effect of Phase Angle.

The theoretically accurate method of integrating wattless power in a three-phase circuit is by the two-wattmeter method, each wattmeter being so compensated that the phase of the pressure flux is displaced 90° with respect to the pressure flux of the corresponding meter used for energy measurement. In the case of an induction meter, the pressure flux will lag 180° behind the pressure producing it. If the phase compensation be inaccurate, and the phase position differ by an angle α from exact opposition, the meter will integrate—

$$i\,v \sin(\phi \pm \alpha) = i\,v \sin\phi \pm i\,v \cos\phi \sin\alpha, \text{ if } \alpha \text{ be small.}$$

The error as a fraction of the true reactive power is—

$$w \cos\phi \sin\alpha.$$

The indications of the reactive meter are often used, in conjunction with those of the energy meter, to determine the energy factor, or the kVAh of the circuit.

The kVAh are calculated from the relation—

$$\text{M} = (\text{W}^2 + \text{X}^2)^{\frac{1}{2}},$$

W being the units and X the reactive kVAh.

The effect of the phase angle of the reactive meter will be to give a value of M—

$$(\text{W}^2 + \text{X}^2 \pm 2\,\text{W}\,\text{X} \sin\alpha)^{\frac{1}{2}}$$
$$= \text{M}\,(1 \pm \sin\phi \cos\phi \sin\alpha).$$

The error in the determination of the kVAh, as a fraction of the true value, is $\frac{1}{2}\,\alpha \sin 2\phi$.

The energy factor calculated from the erroneous value of the reactive kVAh—

$$\text{W}/(\text{W}^2 + \text{X}^2 \pm 2\,\text{W}\,\text{X} \sin\alpha)^{\frac{1}{2}} = \cos\phi\,(1 \pm \tfrac{1}{2}\,\alpha \sin 2\phi).$$

The fractional error in each case has its maximum value when $\sin 2\phi = 1$ or when $\cos\phi = 0{\cdot}707$.

The foregoing calculations apply to a one-phase circuit, but it is not difficult to show that they apply to a two-wattmeter combination for three-phase measurements, if the phase angles of the meters be the same.

The Quadrature-voltage Method.

These results have an important bearing upon a well-known method of metering reactive power in three-phase circuits by ordinary energy meters. In this method the pressure coils of the reactive meter are energised by voltages displaced 90° from those required for energy registration, such quadrature voltages being obtained from mid-point taps on the potential transformer secondary windings or from auto-transformers. If the voltage system is balanced, and these taps be inaccurately placed, a virtual phase angle will be introduced into the combination. Suppose the taps be displaced from the true mid-point 2 per cent. of the secondary voltage, then, since the quadrature voltage is $\frac{1}{2}\sqrt{3}\,v$, the phase angle will be approximately $0{\cdot}04\sqrt{3}$ radian. If the power factor be 0·8 and the circuit approximately balanced, the percentage inaccuracy so introduced is

$$4/\sqrt{3} \,.\, \sin\phi \cos\phi = 1{\cdot}1.$$

Thus, although the error in the position of the mid-point tap has a negligible effect upon the magnitude of the quadrature voltage, the phase angle so occasioned has a material effect upon the accuracy of the energy factor or the kVAh so determined.

If the errors in the position of the transformer taps are in opposite directions, the inaccuracy will be decreased, although, in the case considered, there would not be complete compensation, since the slow element of the meter integrates but 12 per cent. of the total reactive power.

Virtual phase angles are also introduced by a distortion of the voltage triangle, and although errors arising from this cause are not likely to be large for normally balanced circuits, they might easily become appreciable in cases where badly-balanced loads were supplied. The possibility of appreciable errors from the two causes referred to, points to the need of great care in the employment of the method under consideration, if high accuracy in the determination of the energy factor is desired.

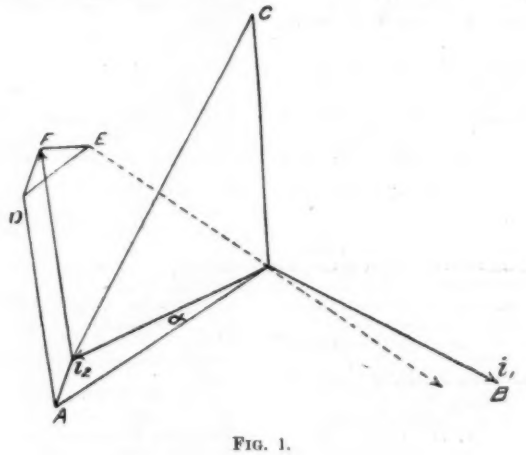


Fig. 1.

The Reversed Meter Method.

An approximate method of metering reactive power in three-phase circuits consists in the use of an ordinary three-phase two-element meter connected up so that the torques generated by the two elements are in opposition. The multiplier for such a meter is $\sqrt{3}$. The meter so connected will integrate—

$$\sqrt{3}\,\text{v}\,\{i_1 \cos(30° - \phi_1) - i_2 \cos(30° + \phi_2)\}.$$

$i_1\,\phi_1$, $i_2\,\phi_2$, applying to the leading and lagging phases respectively. This expression is equivalent to—

$$\tfrac{1}{2}\,\text{v}\,\{i_1(3\cos\phi_1 + \sqrt{3}\sin\phi_1) - i_2(3\cos\phi_2 - \sqrt{3}\sin\phi_2)\}.$$

If $i_1 = i_2$ and $\phi_1 = \phi_2$, this reduces to $\sqrt{3}\,i\,\text{v}\sin\phi$.

A true reactive meter will integrate—

$$\text{v}\,\{-i_1 \sin(30 - \phi_1) + i_2 \sin(30 - \phi_2)\}.$$
$$= \tfrac{1}{2}\,\text{v}\,\{-i_1(\cos\phi_1 - \sqrt{3}\sin\phi_1) + i_2(\cos\phi_2 + \sqrt{3}\sin\phi_2)\}.$$

The excess of the indications of the reversed meter over the true reactive power is—

$$\Delta = 2\,\text{v}\,(i_1 \cos\phi_1 - i_2 \cos\phi_2) = 2\sqrt{3}\,v\,(i_1 \cos\phi_1 - i_2 \cos\phi_2),$$

v being the hypothetical star voltage.

Since a three-phase, three-wire circuit is completely defined by ϕ_1 ϕ_2, i_1 and i_2, we may put $i_2 = m i_1$ and $\phi_2 = \phi_1 + \alpha$.

Whence, the unbalance being small,

$$\Delta = 2/\sqrt{3} \,.\, \{\text{W}\,(1 - m) + \text{X}\,\alpha\}.$$

The kVAh calculated from the readings of the reversed meter will be—

$$\text{M}_1 = (\text{M} + 2\,\text{X}\,\Delta)^{\frac{1}{2}}$$
$$= \text{M}\,\{1 + 2/\sqrt{3} \,.\, \sin\phi\,(1 - m)\cos\phi_1 + \alpha \sin\phi_1\}.$$

The fractional error is—

$$2/\sqrt{3} \cdot \sin\phi \{(1 - m)\cos\phi_1 + a \sin\phi_1\}.$$

The fractional error of the energy factor will, as previously shown, be of the same magnitude.

As a numerical example we may assume that i_2 exceeds i_1 by 5 per cent., and that ϕ_2 exceeds ϕ_1 by 2·8 degrees or 0·05 radian, and that the power factor of the circuit is 0·8.

The percentage error in the kVAh will then be

$$2/\sqrt{3} \times 0{\cdot}6 \{0{\cdot}05 \times 0{\cdot}8 + 0{\cdot}05 \times 0{\cdot}6\} \times 100 = 4{\cdot}8.$$

If the unbalance be such that $i_2 = 0{\cdot}95\ i_1$, ϕ_2 remaining as before, the percentage error will be

$$100 \times 1{\cdot}2/\sqrt{3} \times 0{\cdot}01 = 0{\cdot}7.$$

The maximum error is obtained by differentiating with respect to ϕ the expression—

$$2/\sqrt{3} \sin\phi \{(1 - m)\cos\phi + a \sin\phi\},$$

giving as the condition—

$(1 - m)\cos 2\phi + a \sin 2\phi = 0$, or $\tan 2\phi = -(1 - m)/a$. For the first case considered above $\tan 2\phi = -1$ giving $\phi = 67°$, the error being 6·9 per cent.; in the second case $\phi = 22\frac{1}{2}°$, giving an error of 1 per cent. In this latter case it is easily seen that the error is zero when $\tan\phi = -(1 - m)/a$ and $\phi = 45°$.

It would therefore appear in the light of the foregoing calculation that the possible errors of the method being considered, with a very small defect from an exact balance in the circuit, are so great as seriously to endanger the validity of the method. Especially is this so in view of the fact that power factor tariffs will be most used with large consumers, when the highest accuracy in metering is desirable.

The Single Element Meter Method.

An alternative method of approximately integrating the reactive power in a three-phase circuit is by the use of a one-phase meter connected in the third main and energised by the voltage between lines 1 and 2. Where current transformers are in use the series coil of the reactive meter will carry the resultant of the currents supplying the energy meter. The multiplier for such a meter is $\sqrt{3}$. The meter integrates—

$$\sqrt{3}\ \text{V}\{-i_1\cos(\phi_1 + 30°) + i_2\cos(\phi_2 - 30°)$$
$$= \tfrac{1}{2}\{-i_1(3\cos\phi_1 - \sqrt{3}\sin\phi_1) + i_2(3\cos\phi_2 + \sqrt{3}\sin\phi_2)\}.$$

The difference between this quantity and the true reactive power is—

$$-\text{V}(i_1\cos\phi_1 - i_2\cos\phi_2).$$

The error in the integration of reactive power by the single-element meter is thus seen to be of opposite sign to and one-half the magnitude of the error with the two-element reversed meter. The error in the determination of kVAh and energy factor will also be halved. Manifestly such a meter is preferable on the score both of accuracy and cheapness to a three-phase meter connected with the elements in opposition.

The Unbalance Factor of a Three-phase Circuit.

We have remarked above that a three-phase three-wire circuit is completely defined by i_1 ϕ_1 and m and a, these latter quantities fixing the degree of unbalance of the circuit. The balance factor of a three-phase circuit with a symmetrical voltage system is usually defined as—

$$b^2 = i_0^2/3\,(i_1^2 + i_2^2 + i_3^2),$$

where i_0 is the vector sum of the three currents.

It will be useful to obtain the balance factor in terms of m and a in order that an idea may be gained of the balance factor of a circuit which cannot accurately be metered for reactive power by the reversed-meter method.

The third current is given by—

$$i_3^2 = i_1^2 + i_2^2 - 2\,i_1\,i_2\cos(60° - a)$$
$$= i_1^2\{1 + m^2 - 2m\cos(60° - a)\}$$

Whence $3\sum i^2 = 2\,i_1^2\{1 + m^2 - m\cos(60° - a)\}$

We may obtain a value for i_0 by calculating the maximum power in the circuit by varying ϕ, and dividing by $\text{V}/\sqrt{3}$, the star voltage.

The power is—

$$i_1\,\text{V}\{\cos(30 - \phi_1) + m\cos(30 + a + \phi_2)\}$$
$$= i_1\,\text{V}(\text{A}\cos\phi + \text{B}\sin\phi)$$

where $\text{A} = \cos 30° + m\cos(30 + a)$

$\text{B} = \sin 30° - m\cos(30 + a)$

or $i_1\,\text{V}(\text{A}^2 + \text{B}^2)^{\frac{1}{2}}\sin(\phi + \theta)$ where $\theta = \text{arc tan } \text{A}/\text{B}$.

The maximum value of the power occurs when $\phi + \theta = 90°$, and is then—

$$i_1\,\text{V}(\text{A}^2 + \text{B}^2)^{\frac{1}{2}}$$

then $i_0^2 = 3\,i_1(\text{A}^2 + \text{B}^2)$

$$= 3\,i_1\{1 + m^2 + 2m\cos(60 + a)\}.$$

We therefore obtain—

$$b^2 = \{1 + m^2 + 2m\cos(60 + a)\}$$
$$\div 2\{1 + m^2 - m\cos(60 - a)\}.$$

The unbalance factor u, as defined by Russell, is given by—

$$u^2 = 1 - b^2 = (1 + m^2 - 2m\cos a)$$
$$\div 2\{1 + m^2 - m\cos(60 - a)\}.$$

The balance factor in the case considered above, m being 1·05 and a 2·8°, is—

$$\left[\frac{1 + (1{\cdot}05)^2 + 2{\cdot}1\cos 62{\cdot}8}{2\{1 + (1{\cdot}05)^2 - 1{\cdot}05\cos 57{\cdot}2\}}\right]^{\frac{1}{2}} = 0{\cdot}999$$

and $u^2 = (1 + 1{\cdot}1025 - 2{\cdot}1 \times 0{\cdot}9988)/3{\cdot}0706 = 0{\cdot}0016$, whence $u = 0{\cdot}04$.

It therefore appears that the circuit considered has a balance factor differing from unity by a very small amount, yet, notwithstanding this, the error of the approximate method of reactive power integration may be serious. It also appears that the fractional error may be of the same order as the unbalance factor as defined above.

The above results are illustrated geometrically in the diagram, fig. 1. OA, OB, OC are the directions of the three star voltages. $\text{O}i_1$, $\text{O}i_2$ are the currents i_1 and i_2. Making $\text{OF} = \text{O}i_1$, i_2 F is the third current i_3, OA is equal to $\text{O}i_1$ the angle i_2 OA is equal to a, and Ai_2 is $i_2(1 + m^2 - 2m\cos a)$. Drawing AD equal and parallel to i_3, and advancing the vectors i_2 and i_1, 120° and 240° respectively, we obtain $v \times \text{DE} = \text{Q}$ as the amplitude of the double frequency ripple in the power flow in the circuit. Since the angle DFE is 120°, $\text{DE} = \sqrt{3}$ Ai_3, and the unbalance factor can be put in the form—

$$u^2 = \text{Q}^2/3\ v\ \Sigma i^2,$$

as pointed out by Russell.

An Approximate Method of Directly Integrating kVAh.

If the unbalance of a circuit is so small that the reactive power can be integrated with a sufficient degree of accuracy by the reversed meter method, a simple means of directly sustaining the kVAh within a useful range of power factor can easily be deduced. If p_1 and p_2 are the watts metered by the leading and lagging elements of a three-phase meter, then—

$$\text{W} = p_1 + p_2 \text{ and } \text{X}/\sqrt{3} = p_1 - p_2,$$

whence—

$$2\,p_1 = \text{W} + \text{X}/\sqrt{3} = 2/\sqrt{3} \cdot \text{M}\,(\sqrt{3}/2\cos\phi + \sin\phi/2)$$
$$= 2/\sqrt{3} \cdot \text{M}\cos(\phi - 30°).$$

If we put $\phi = 30 \pm \theta$

$$\sqrt{3}\,p_1 = \text{M}\cos\pm\theta.$$

This result indicates that a one-phase meter connected as the leading element of a three-phase combination will, with a multiplier of $\sqrt{3}$, integrate the kVAh in a circuit, the average power factor of which is 0·866. If the permissible inaccuracy of the method due to power factor variation be 2 per cent., the maximum value of θ is 11°, giving limiting values of the power factor of 0·75 and 0·94.

Patent Office Finance.—The Report of the Comptroller-General of Patents, Designs, and Trade Marks for the year 1922 shows that the receipts exceeded the expenditure by £74,000, although there was a decrease in the former. The number of patent applications received was 35,494, an increase of 362. There were also increases in the applications for the registrations of designs (15,736) and trade marks (12,397).

HIGH-PRESSURE DEVELOPMENTS IN AMERICA.

By ERNEST V. PANNELL.

THE initial operation of a power system at 220,000 volts has already taken place in California, but it cannot be said that any outstanding milestone in progress is indicated thereby. The construction and operation of the modern high-pressure network is now a matter of everyday engineering, and the last radical advance was the inception of 110 kilovolts nearly 15 years ago.

What is the reason for the use of such high potentials? Obviously it is not entirely a matter of distance; transmission distances, owing to interconnection of systems, are actually shorter than they were ten years ago. Nor is it entirely a matter of constructional economy, for if a power plant is producing 50,000 kVA and transmitting to a city a hundred miles away at 110 kV, it will surely cost a great deal more to increase the voltage by 100 per cent. for the same amount of power.

The reason is simply one of carrying capacity. If the above-mentioned system requires the development of 200,000 kVA instead of 50,000, then the lower voltage will mean the use of very large conductors, leading to difficult construction or to a multiplication of circuits. It will involve heavier loads to be handled by the switches and more serious short-circuit conditions, to say nothing of other disadvantages such as greater power loss. The higher voltage will require none of these things; in fact, it affords the only solution to the problem of handling such large blocks of power as 200,000 kW.

The power requirements of modern American cities vary from 0.20 up to 1.00 kW per unit of the population, depending upon the industrial development of the community. Recent research shows the city of Baltimore, with a population of 734,000, to require a maximum of 132,000 kW, a ratio corresponding to the lower limit above, whilst Allentown, Pennsylvania, a highly-industrialised city, uses nearly 72,000 kW with a population of 74,000. Newark, New Jersey, is an average example with a maximum demand of 200,000 kW for 400,000 population. In the West, however, where electric power entirely replaces fuel in industrial life, the ratio is much higher, and one kilowatt per unit of population is more nearly approximated to. The two principal cities in the high-pressure power zone are Los Angeles with a population of one million, and San Francisco with about 800,000. Under these conditions, where such cities receive their energy from a hydro-electric development many miles away, a very large block of power must be conveyed over the transmission lines. So it is that, although 10,000 kW per circuit was at one time considered a fair value, 50,000 kW is now quite usual, and at the present time transmission lines are being designed to carry from 80,000 to 100,000 kW for each circuit.

There is at present a severe limit to the capacity of high-pressure oil switches, and the maximum satisfactory rating is about 300 amperes. This switching limitation virtually determines the maximum amount of power which can be sent over a three-wire transmission circuit at 90 per cent. power factor, as follows:—

55 kVA	25,000 kW
110 kVA	50,000 kW
220 kVA	100,000 kW

Similarly, there is a distinct limit to the maximum rating for which transformers can be built with desirable characteristics. The manufacturers offer a rating of 30,000 kVA for a single-phase unit at 220 kV, whereas the largest size yet put into operation is little more than half this, so it cannot be said that the limitation is a serious one up to the present.

The following table shows just what arrangements are used by two of the largest power corporations for their 220-kV operations:—

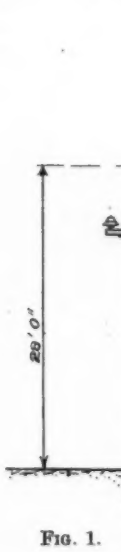


FIG. 1.

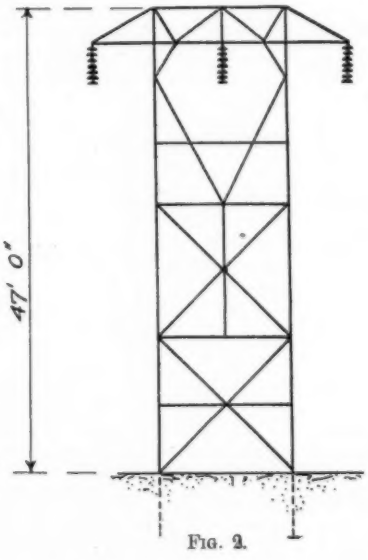


FIG. 2.

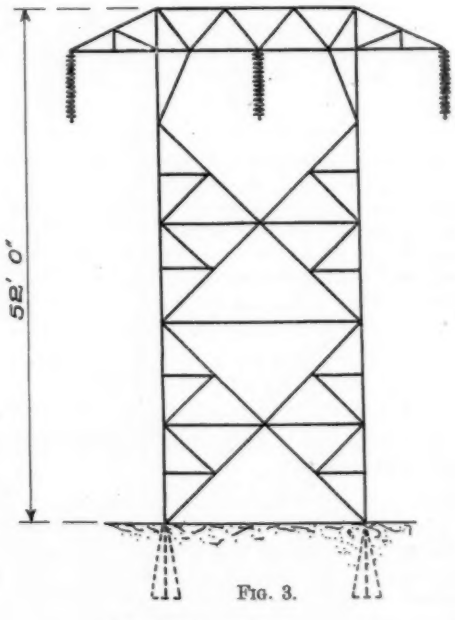


FIG. 3.

220-kV TRANSMISSION.

System	Pacific Gas & Elec.	So. Cal. Edison
Power house	Pit River, Cal.	Big Creek, Cal.
Total kVA developed ...	105,000	118,500
,, ,, ultimate ...	200,000	240,000
Rating per transformer ...	16,666	(*a*) 8,333
		(*b*) 7,500
Transformers	3	(*a*) 3
		(*b*) 3
		(*a*) 4
No. of Banks connected ...	2	(*b*) 1
Total transformer capacity	100,000	122,500
Transmission circuits ...	2	2
kVA per circuit, present...	50,000	61,250
,, ,, ultimate..	100,000	80,000 (3 lines)
Distance of transmission, miles	202	240

(*a*) Stations Nos. 1 and 2, Auto-Transformers. (*b*) Station No. 8.

Perhaps the most noteworthy point is the use of auto-transformers in the Big Creek power houses. This system, it will be remembered, was built in 1913 to operate at 150 kilovolts, and with the present increase of 50 per cent. in operating voltage the original transformers are retained, but auto-transformers are connected to the high-pressure busbar to step up from 150 to 220 kilovolts, which is the most economical arrangement. All these high-pressure transformers have their neutral point grounded, so that insulation can be graded

in value throughout the high-pressure winding. Actual illustrations are shown herewith of the development of line construction. Taking 55 kilovolts as a starting point, a typical transmission line is that of the Nevada California Power Company, employing a single circuit, about 0.08 sq. in. copper wires, with cedar poles and pin-type insulators (fig. 1). On such construction as this it would not be good practice to transmit more than 5,000 kW. Lightning and transient disturbances are of a serious nature on a line of this type owing to the relatively low value of the insulation, and it would be unwise to concentrate an important load upon one pole line.

Doubling this transmission voltage gives 110 kilovolts, and the drawing, fig. 2, shows construction on the line of the Chile Exploration Company. Steel construction replaces wood, stranded copper of 0.13 sq. in. and seven-unit suspension insulators are incorporated. A maximum demand of 20,000 kVA is taken care of by one circuit, and the design is clearly much more immune from interruptions than the 55-kV pole line.

Advancing a step further, and again increasing the voltage by 100 per cent. to the present maximum value of 220 kV, the construction of the Pacific Gas and Electric Co.'s lines affords a good illustration of modern practice. In fundamentals there is no difference from the last example, so it is true to say that modern high-pressure design problems were virtually solved before the inception of 110 kilovolts. This line, fig. 3, of the Pacific Gas Company uses steel towers with conductors of 0.40 sq. in. aluminium, reinforced with a steel core and equivalent to copper of 0.24 sq. in. area. Insulation must be very liberal, so that 14 graded disks are used to each suspension insulator. Needless to say, this provides a most liberal safety factor against interruption by lightning or transient surges, so much so that not only is the usual ground wire dispensed with, but no lightning arresters are used. At present transformers of 50,000-kVA capacity are connected to this circuit, but the transmission line will probably carry double this when the power sources are fully developed. Whilst this transmission would cost about £3,000 per mile of single circuit, as compared with about £500 per mile of 55-kV pole line, it must be remembered that it will ultimately carry twenty times as much power, and notwithstanding the far greater security and lower maintenance, the capital cost of the higher-voltage line per kilowatt will be only one-third the cost of the wood-pole construction.

COUNTRY-HOUSE LIGHTING PLANT.

The Armstrong, Whitworth System.

MESSRS. SIR W. ARMSTRONG, WHITWORTH & CO., LTD., who have recently introduced a country-house lighting set, hold that there are pronounced advantages in favour of installing sets which include storage batteries of reasonable size, rather than endeavouring to cut these down to the minimum or eliminating them altogether.

Any internal-combustion engine has a much higher fuel consumption per h.p.-hour when running light than at or near full load; and a country-house set of 1½ kW for, say, a 60-light house runs at full load only when all the lamps are in use. In most cases the average demand is about half a kilowatt or less, and therefore the plant is running uneconomically most of the time.

If a small battery is used to supply current for a few lights only, or perhaps solely for starting purposes, the position is aggravated. Such batteries are necessarily sources of trouble, as they are used under more or less unsound conditions as regards proper charge and discharge.

The problem of proportioning the components of the plant so as to obtain the best all-round results is solved by any system which ensures that the engine runs on a comparatively high-load factor, and that the battery is large enough to meet safely the maximum current demand. At the same time, the battery should not be so large that it only needs to be charged at long intervals. It is also very desirable to proportion the generating plant so that the time required for charging is not too great, but this must not be taken to the extreme of charging the battery at too high a rate.

The last-mentioned point has been fully considered by Messrs. Armstrong, Whitworth & Co. in selecting the dynamo characteristic of their "A.W." semi-automatic set, fig. 1. Many sets charge at a constant or even a rising kilowatt rate; thus a 2-kW 50-volt set will commence charging at about 35 amperes 56 volts, and finish at about 28 amperes 70 volts—*i.e.*, the kW input is about constant. Such a set is usually supplied with a battery of not more than 160 ampere-hours' capacity, and the normal charging rate recommended by the battery makers is in the neighbourhood of 20 amperes. Whilst there is little harm in charging at high rates when the battery is partly discharged, the practice is not to be recommended when near the end of a charge if long battery life is aimed at. The A.W. dynamo is so designed and adjusted that the charging current begins at the value corresponding to the full-load capacity of the set, but as the voltage rises the current falls more quickly than is usual, and finishes even slightly below the normal charging rate for the battery. The load factor is still a good one, giving economy in working, and the battery is kept within commercial limits as regards price, without its life being shortened by high charging rates at the end of charge.

A further point of interest in country-house working is that where a set is designed to include a drooping charging characteristic and where the battery consists of a suitable number and size of cells, there is no need for step-by-step end-cell regulation. The normal 50-volt battery has 27 cells, and this gives a voltage of about 56 V on a fully-charged battery. It is considered good practice to cut out, say, three cells at the beginning of discharge, and to insert them one at a time as the need arises. It is found that the first cell has to be put in almost immediately after the discharge begins, the second at about half discharge, and the third almost at the end of discharge. These cells ought then to be cut out during the progress of charging, because they reach full charge before the rest of the battery. It is common knowledge that this is rarely done, with the result that the end cells quickly fail on account of repeated overcharges.

In the case of A.W. semi-automatic sets only 26 cells are used for 50 volts, and the full number is kept on the line throughout discharge. This gives a voltage range which is stated to extend from about 54 to 49, the average being almost exactly 50, owing to the rapid initial fall. It is claimed that

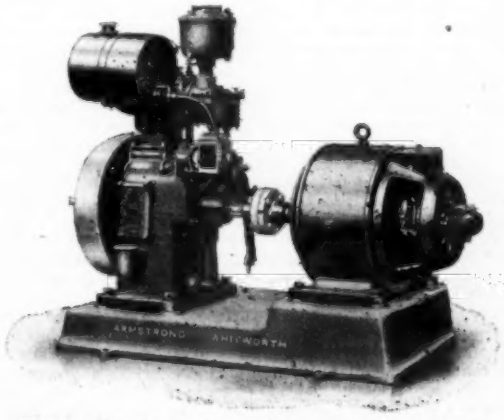


FIG. 1.—THE ARMSTRONG, WHITWORTH LIGHTING SET.

the comparative brilliance of the lamps for the first half-hour or so of discharge is not detrimental to their life, as it is off-set by the increased percentage life during the longer period when the voltage is between 50 and 49 V. At 49 V the candle-power is reduced by about 7 per cent.—sufficient to give warning that the battery is approaching a discharged condition and needs recharging next day.

When the semi-automatic set is working on combined charge and discharge—a rare occurrence with the average country-house plant—a fixed number of end cells is cut out, such that the average lamp voltage during the charging period if about 50 V, and, as on discharge, any diminution of lamp life at the higher voltage towards the end of charge is offset by the gain in life at the lower voltage when charging has only just begun.

It will be obvious from the above remarks that the guiding principle in the design of the A.W. plant has been to cut out all possible complications and thus to produce a set which can be left entirely without adjustments; but where a client wishes to have complete control of the voltage during charge and discharge, and does not object to adjusting end-cell switches, he is offered a fully hand-regulated board, with the optional addition of a motor starter for the engine.

The semi-automatic switchboard has a very small number of working parts, all mounted on the front of the board; one handle controls all functions, *viz.*: starting from the battery, charging, running the engine for power, and short-circuiting the magneto when shutting down.

Two relays are used for control. One operates at maximum and minimum battery voltage, short-circuiting the hold-on coil of the starting handle at high voltage, and thus releasing it at the end of charge, whilst it also operates an indicating signal when the voltage falls to any desired value in discharge. The second relay is an automatic cut-out operating in emergency on reverse current only. In the larger sizes a change-over switch is added for inserting series turns, for running direct to the lights without the battery.

As regards the engine, the paraffin vaporiser is of very compact and net design, and combines the use of heated inlet air with a hot exhaust injection, arranged in such a manner that not only is knocking prevented but running at all loads is obtained without any adjustment after the first few minutes. The bearings are of phosphor bronze, of ample dimensions, and a simple glandless plunger pump delivers a copious supply of oil to all parts. The use of a large breather valve on the crankcase allows objectionable vapours to escape, and creates a slight suction at each end of the shaft, thus preventing oil flinging, and keeping the engine and engine-house clean.

THE APPLICATION OF PHYSICS TO THE CERAMIC INDUSTRIES.

DR. J. W. MELLOR lectured on this subject before the Institute of Physics on May 9th. The occasion was the fourth of the series of lectures on "Physics in Industry," being given under the auspices of the Institute. Sir J. J. THOMSON (the President) was in the chair.

At the outset Dr. Mellor drew attention to the scarcity of physicists in the ceramic industry, in spite of the fact that so many physical problems await solution. While this may be partly—or even to a great extent—the fault of the manufacturer, who has failed properly to realise how science can help him to improve his processes, the physicists themselves are not, in Dr. Mellor's opinion, free from blame, for they are too often brought up in a frame of mind ill adapted to the correlation of theoretical work with industrial practice.

Every branch of physics has applications in the ceramic and glass industries. We can here only refer to the more important examples quoted by Dr. Mellor and, like him, eliminate applications common to other industries. The applications of light are numerous and varied, particularly in connection with colour, and the work of physicists on the production of imitation natural light is being followed by ceramists with keen interest, for the matching of coloured glazes by artificial illumination is always difficult and sometimes impossible. There are, for example, some chrome colours which appear green in daylight, and crimson, pink or purple in gas or electric light. The problem of producing a lamp bulb through which the red filament would appear blue arose during the war. Had the absorption spectra of the oxides used in such glasses been available the solution would at once have been arrived at. As it was, it was only found after considerable experimenting that the desired effect was obtained by adding chromic oxide to the cobalt oxide used in making blue lamp bulbs.

The processes of making satisfactory silica bricks depend largely on the discovery made by crystallographists of the existence of two crystalline forms of silica, a discovery that has rendered the manufacture of these bricks a process controllable by science instead of rule-of-thumb. Dr. Mellor made the important announcement that Sir William Bragg's work on X-ray spectra promises shortly to do for the firebrick manufacturer what studies in index of refraction have done for the silica brick manufacturer.

Applications of magnetism in ceramics have been but partially explored. The main problem involves the separation of particles of metallic iron from clay slip. The use of a train of horseshoe magnets is giving way to systems of electromagnets, as in the machine made by the Rapid Magnetting Co., a feature of which is that the passage of dirty slip into the purified slip is prevented if the electromagnets cease to work. A problem awaiting solution is to remove particles of cupriferous pyrites from fireclays used in making certain types of sanitary goods. Neither the ordinary electromagnetic separator nor the electrostatic separator has yet proved successful.

The use of electricity has been highly satisfactory in the high temperature testing furnace, but Dr. Mellor had not come across an electric furnace likely to give satisfactory results in firing pottery, although, for crucible work, melting glasses and frits and the like, electric heating had been successful, and would come into more general use if power were cheaper. Some pretty problems in heat distribution arise where electric heating is employed, quite different from those occurring with gas or coal firing, where the burning gas itself distributes the heat. The lecturer thought that with the electrical heating of a large chamber there would have to be a subsidiary mechanism to ensure the better circulation of gas so as to get good convective heating.

This brings us to the other heat problems, where the services of the engineer-physicist should be helpful to the ceramist. His opportunities become at once apparent when it is realised that in firing biscuit-ware, for example, 98 per cent. of the fuel is a dead charge against the oven saggars, &c., although in firing building bricks the processes are more efficient. Many practical, apart from technical, difficulties block the path of the inventor of an efficient furnace, for scrapping existing plant in an old-established industry like the ceramic, means scrapping the traditional experience of generations of workmen—a most important consideration, usually overlooked.

The drying of clay and clay-ware also presents a fine series of physical problems having important practical applications, because of the losses which occur owing to the development of drying cracks or, if the drying be sufficiently slow, on account of the inordinately long time it takes to dry large masses. The problem involves working out the distribution of water in the interior of a drying mass of clay, taking into account the special surface conditions of evaporation determined by the humidity of the surrounding atmosphere. The problem is analogous to that concerned with the flow of heat, but far more complex. Allied is the subject of contraction strains set up during the firing or drying of special shapes, such as are frequently demanded by the designer of chemical plant, furnaces, coke ovens, and sanitary ware. The work now being conducted by Professor Lees on the thermal strains in monolithic kilns may be preliminary to a study of the more complex problem.

The glazing of pottery is a subject likewise deserving the attention of the physicist, who will have to consider not only the relative coefficients of thermal expansion of glaze and body, but also the tensile strength of the former and the physico-chemical relations of the two brought about by the solution of the body in the glaze.

We have touched upon but a few of the points of contact between the physicist and the ceramist indicated by Dr. Mellor. The conclusion to be reached is one applicable to most industries. If efficiency is be maintained and discovery stimulated, the manufacturer and the man of science must work hand in hand, and even in what are usually regarded as chemical industries, an appreciation of physics is as necessary to progress as an appreciation of chemistry which, among enlightened manufacturers, is now all but universal.

Destruction of Large Turbo-Generator.—In a recent issue of *Power* details were given of the breakdown and destruction of a 10,000-kW turbo-generator in the Mill Street station of the Indianapolis Light & Heat Co., in April. The machine had been turning over for about an hour to warm it up preparatory to putting it on load. It was being brought up to full speed when the failure occurred. The rotor shaft broke and the rotor burst through the casing, entirely destroying the machine and damaging two other sets in the station. Two attendants were injured, but no one was killed. The cause of the failure remains in doubt. An official expressed the opinion that a "runaway" started the damage. It was difficult to judge from the broken parts which was the initial break. It may have been that the first-stage rotor disk failed where the pins held it to a sleeve which, in turn, was keyed to the shaft, or that one of the low-pressure disks failed first and threw the rotor out of balance. Pieces were broken out of the disks in several places.

Lighting in Factories.—Welfare Pamphlet No. 7, recently issued by the Home Office (Stationery Office, 4d. net), emphasises the importance of good lighting in factories and workshops both with regard to the workers' efficiency and their well-being. The fundamental requisites of good lighting are dealt with in some detail, and are stated as: Adequacy, suitability, constancy and uniformity, prevention of glare, and avoidance of shadow. Natural and artificial lighting are compared, and methods of artificial lighting, *e.g.*, local and general, are briefly described. The causes of unsatisfactory lighting, both natural and artificial, are noted and include bad design of buildings, dirty walls, ceilings, and windows, inadequate and antiquated methods, and neglect of upkeep. One section is devoted to a study of the illumination required in relation to the class of work, and the concluding chapter gives a number of points which should be considered in the planning of a lighting installation.

There are three appendices: "The Factory Lighting Committee's Recommendations"; "Illumination and its Measurement"; and "Examples of Good and Bad Lighting."

BUSINESS NOTES.

Bankruptcy Proceedings.—LAWRANCE ELECTRICAL TRADING Co. (G. J. C. Thorne and A. H. Thorne), late of 159, High Street, Notting Hill Gate, W. The first meeting of creditors was held on May 24th, before Mr. D. Williams, Official Receiver, at the London Bankruptcy Court. The debtors filed their own petition on May 9th, and have lodged accounts showing unsecured liabilities £1,105 against assets valued at £379, and consisting of cash £6; stock in trade, £100; machinery, £85; fixtures, £30; balance due under a lighting contract, £25; good book debts, £110; and doubtful and bad debts, £50, estimated to yield £22. The deficiency is estimated at £727. The chairman reported that the debtor, G. J. C. Thorne, had stated that he served in the Army between 1915 and 1919, and for the next ten months he was in employment. At the end of that time, with £100 savings, he and Mr. A. E. Burrow commenced business as electrical engineers in Cornwall; he (debtor) withdrew from that business at the end of 1921, receiving £149 as his share of the concern; a deed of dissolution was prepared, but it was not gazetted. The debtor then came to London and in February, 1922, started business in partnership with his brother, under a verbal agreement, as electrical engineers, in the name or style of the Lawrance Electrical Trading Co. In addition they carried on business as general agents under the name of Thorne Bros., taking premises at 41, South Molton Street, W, and having a borrowed capital of £100, which was still owing. Six months later they removed to High Street, Notting Hill Gate; they were equal partners, each drew £4 a week from the business. A fairly good trade was established, but, owing to lack of capital, they found it was impossible to carry on, and at a private meeting of creditors held on May 7th, they offered to execute a deed of assignment under which a cash creditor for £600 was willing to stand aside for the benefit of the trade creditors. That offer, however, was turned down, and a resolution for bankruptcy having been passed, the debtors filed their petition and closed down the business. The failure was attributed to trading on borrowed money. A creditor drew attention to the claim of the Rev. A. S. Mills, returned as a creditor for £560 in respect of cash advances, and suggested that the Official Receiver should make the necessary inquiries to discover whether that gentleman was not in reality a partner of the firm. He pointed out that the business papers used by the debtors contained Mr. Mills's name with those of the debtors. The debtor, G. J. C. Thorne, explained that they had known Mr. Mills for some years, and when they moved to High Street they were of opinion that the use of his name would be helpful as Mr. Mills was well known in that neighbourhood. As a matter of fact, they did not go through the formality of obtaining his consent, and when he raised an objection to their procedure, they gave the printers instruction to rule out his name from the business papers, which was done. Mr. Mills had advanced them various sums for the purposes of the business, but he never was a partner in any sense of the term. The chairman said, of course, full inquiry would be made into all the circumstances, but it seemed to him that Mr. Mills's claim, if properly substantiated, would have to be admitted for dividend with the trade liabilities. It rested with those creditors who regarded him in the light of a partner, to proceed against him for payment, as they might be advised. The receiving order was made again George John Cecil Thorne and Albert Harry Thorne, lately carrying on business under the style, firm or name of the Lawrance Electrical Trading Co.; the order was not against Mr. Mills, and clearly he was not subject to it. The case was left in the hands of the Official Receiver to be wound up in bankruptcy.

The following are creditors:—

	£		£
Argyle Press	18	Metropolitan-Vickers Electrical Co., Ltd.	13
British Thomson-Houston Co., Ltd.	19	Motolite Dynamos, Ltd.	15
Brown & Williams	18	Mills, A. S., Rev.	560
Central Ignition Co.	45	Stella Lamp Co., Ltd.	23
County of London Engineering Co., Ltd.	50	Three Star Accumulator Co., Ltd.	34
Degua Electric Co., Ltd. ...	15	Vgwechew, A.	12
Henderson Bros.	15	Selfridge & Co., Ltd.	63
Einva Just	60	Barclay's Bank, Ltd.	17

T. G. SLATER (Slater Bros.), electrical engineer, 25, Dickinson Street, Manchester.—Receiving order made May 18th, on debtor's own petition.

A. H. DUFFIN & G. KERSHAW (A. H. Duffin & Co.), electrical engineers and contractors, Provincial Buildings, Conway Road, Colwyn Bay.—First meeting June 1st, at the Official Receiver's office, St. Peter's Churchyard, The Cross, Chester. Public examination July 13th, at the Court House, Bangor.

F. WILDE (Liverpool Engineering Co.), electrical engineer, 18-20, Vauxhall Road, Liverpool.—First dividend of 1s. 9d. in the £, payable at the Trustee's office, 19, Castle Street, Liverpool.

RICHMOND RUDD, Long Ashton, Somerset, electrical engineer.—The statement of affairs shows liabilities of £261, against assets of £132, or a deficiency of £128. Debtor attributes his failure to want of capital, pressure by creditors, and costs in connection therewith. It appears that in May, 1919, he commenced business as an electrical engineer at Long Ashton, and purchased a cottage for £155 with his savings. He had no other capital, but about three months later obtained an overdraft at the bank, giving as security a mortgage upon the house. He states that the business was successful for the first two years, but then he entered into a large contract with a firm which, upon its going into liquidation, owed him a balance of account amounting to £280. Debtor had to wait eight months before the account was paid, but in the meantime some of his creditors began to sue him, and since then his business had steadily diminished. He became aware of his position six months ago.

A. W. VERITY (lately carrying on business in co-partnership with H. Lee, as Verity & Lee, electrical contractors), electrician, 143a, Leeds Road, Bradford.—First meeting June 5th, at the Official Receiver's office, 12, Duke Street, Bradford. Public examination July 11th, at the County Court, Bradford.

D. W. CLOSE, Kilbirnie, trading as the Ayrshire Electrical Co.—This examination in bankruptcy took place before Sheriff Robertson in Kilmarnock Sheriff Court on May 23rd. Bankrupt stated that he commenced business in February, 1922, with a capital of £100, which was afterwards augmented to £200. Under an agreement with those who were financially behind the business he drew £5 10s. a week for his own use. The accounts were to be prepared and a balance sheet made up by two friends who were financially backing him. He understood there had been a balance sheet drawn up but he had never seen it. He had not the books of the firm and had not seen them since November. They were in the hands of one of his financial backers, and would be available now for the trustee. He accounted for his failure through capital expenditure in expectation of better trade. He expected to have the electrical work in and around Kilbirnie district, but the electric current was not supplied and the orders he anticipated did not come forward. The examination was closed. Mr. Maurice Crichton, C.A., Glasgow, trustee; Mr. James M. Inglis, Kilmarnock, agent.

Private Arrangement.—J. CROWLEY and J. I. FRANCIS, electrical engineers and contractors, trading as Crowley and Francis, 24, Orange Street, Swansea.—The creditors interested herein were called together recently at the offices of Messrs. Poppleton, Appleby & Hawkins, accountants and auditors, 4, Charterhouse Square, E.C., when a statement of affairs was presented, which showed liabilities of £549, against assets amounting to £434. It was stated that the debtors had carried on the business in partnership since September, 1920. The debtors made an offer of a composition of 17s. 6d. in the £, payable as to 2s. 6d. in three months, and then 5s. in the £ every subsequent six months. After a short discussion it was decided to accept the debtors' offer and that a deed should be executed to Mr. E. H. Hawkins, together with a committee consisting of the representatives of the Metallic Seamless Tube Co., the Edison Swan Electric Co., Ltd., and the Siemens and English Electric Lamp Co., Ltd. The following are creditors:—

	£		£
British Thomson-Houston Co., Ltd.	12	Hyman, S.	61
Bankers	40	Jenkins, T. P.	19
Concordia Elec. Wire Co., Ltd.	27	Metallic Seamless Tube Co. ...	120
Crabtree, J. A., & Co., Ltd. ...	16	Simpson, Baker & Co.	14
Edison Swan Electric Co., Ltd.	115	Siemens & English Elec. Lamp Co.	80
Falk, Stadelmann & Co., Ltd. ...	36	Webber, P.	30

Company Liquidations.—ANODE WIRELESS AND SCIENTIFIC INSTRUMENTS, LTD., 265, Strand, W.C.—Under a compulsory winding-up order, made against this company last March, accounts have been lodged showing unsecured debts, £1,528; a partly secured creditor £648 (security valued at £600); and preferential claims, £268; the assets are valued at £709; the deficiency in assets to meet liabilities is estimated at £1,135; and the total deficiency as regards shareholders at £8,458; the issued capital consists of 7,323 ordinary shares of £1 each. Mr. G. D. Pepys, Official Receiver and Liquidator, reports that the company was registered on October 6th, 1922, with a nominal capital of £30,000, for the purpose of taking over as a going concern the business of Anode, Ltd., scientific instrument makers, and to carry on business as electricians, manufacturers of generators and other electrical apparatus. The company was promoted by Messrs. P. R. Minvalla, W. E. Peek, and A. H. Lunniss. The qualification of a director was the holding of 500 shares and the remuneration was £150 per annum, with £200 to the chairman, but agreements were subsequently entered into providing for the five directors to act as managing director, works manager, technical director, superintending director, and publicity and sales manager respectively at salaries of £450 per annum each. The Registrar's certificate authorising the company to commence business was issued on October 17th, 1922, and on October 20th, 1922, the company entered into an agreement with Anode, Ltd., for the purchase of the business above-mentioned (which had been started by Peek & Lunniss in 1919), together with all plant, machinery, office furniture, patents, and benefit of all pending contracts. The consideration was fixed at £6,300, to be satisfied as to £800 in cash, and as to

£5,500 in fully-paid shares. The shares were duly issued, but only £200 was paid on account of the cash portion of the consideration. The business was carried on at 47, King's Road, Camden Town, with the registered office at 255, Strand, W.C., but owing to shortness of capital, promises to provide further sums being unfulfilled, the company on January 19th, 1923, passed an extraordinary resolution for voluntary liquidation and the appointment as liquidator of Mr. E. S. Howard, 56, Budge Row, E.C., chartered accountant. The failure and insolvency of the company are attributed by the secretary to want of capital to carry the company over the initial period, during which, in his opinion, it was bound to run at a loss. Peek, Lunniss & Reyner concur in this, and state that the company was started on a £10,000 capital basis. The five directors signed a letter, dated September 21st, 1922, to Anode, Ltd., agreeing to underwrite 10,000 shares, at a commission of 5 per cent., and there appears to be a liability on them thereunder to contribute to the assets of the company.

W. J. Bristow & Co., Ltd., gas and electrical shade manufacturers, Windmill Street, London.—Pursuant to Section 188 of the Companies (Consolidation) Act, a meeting of the creditors in this matter was held on May 18th at the offices of Mr. F. T. Shearcroft, certified accountant, 22, Newgate Street, E.C., when a statement of affairs presented showed liabilities amounting to £1,384, and assets £142, or a deficiency of £1,242. The company was formed in January, 1922, to take over the business of W. J. Bristow, the consideration for the sale of the business being £999. The present position was attributed to heavy losses on the employment of travellers and inability to obtain further capital. After discussion the appointment of the liquidator (Mr. Shearcroft) was confirmed.

W. Blackburn (Kew), Ltd., 110, Kew Green, Surrey, electrical engineers.—The creditors interested herein were called together recently at the premises of the company, when Mr. W. Blackburn, the liquidator in the voluntary liquidation submitted a statement of affairs, which showed liabilities of £523, while the assets were estimated to realise £249. The liquidator stated that the company was registered with a nominal capital of £1,000, of which £665 had been issued, and since its incorporation it had carried on business at a loss of rather more than £900. Since his appointment he had been endeavouring to dispose of the assets, but so far without success. The bailiff had levied execution for creditors for small amounts.

During the discussion which took place it was stated that there was some question as to whether the resolution passed for voluntary liquidation was in order, and the creditors decided that a fresh meeting of the shareholders should be convened in order that another resolution for voluntary liquidation might be passed with Mr. C. Latham, of 15, Eastcheap, E.C., as liquidator. The following are creditors:—

	£		£
Vandervell, C. A.	103	Norman & Clark	18
L.P.S. Electrical Co. ...	12	Blackburn, W.	62
Marconi Company	32	Rent	59
Radio Company	16	Rates	15
Fellowes Magneto Co. ...	22	Wages and salaries ...	13
British Thomson-Houston Co.	16	Advertising accounts ...	51
Reliance Engineering Co.	11		

Dissolutions of Partnership.—Walker & Hutton, electrical engineers, 1, Harcourt Place, Scarborough.—Messrs. J. Hutton, E. Thorp, and C. Hawson have dissolved partnership.

George Boyer, electric welders and boiler experts, 69, Trafalgar Street, and 103, Radford Boulevard, Nottingham.—Mr. G. Boyer and R. Bignall have dissolved partnership. Debts will be attended to by Messrs. H. Bradfield & Sons, accountants, 13, St. Peter's Gate, Nottingham.

Clayton, Mathers & Co., electrical and mechanical engineers, 67, Wortley Lane, Leeds.—Mr. J. S. Mathers, Mr. J. Clayton and Mr. R. Chadwick have dissolved partnership. Debts will be attended to by Messrs. Clayton & Chadwick, who will continue the business.

Trade Announcements.—Mr. Ivan Fawcett, A.M.I.E.E., has resigned his position on the staff of Mr. R. R. Paton and has commenced business at 4, Stuart Street, Cardiff, as Fawcett & Co., electrical engineers and agents. He desires to receive catalogues, lists, &c.

The Western Wireless & Electrical Co. (Messrs. A. G. Williams and E. J. Watts) has opened premises at 98a, Fisherton Street, Salisbury, for the supply of wireless and electrical goods.

Mr. William G. Dodd, electrical engineer and contractor, has opened new premises at 175, High Street, Ayr.

Messrs. Henry Freedman & Co. have removed to larger premises at 39, Duke Street, near Fenchurch Street, E.C.3.

The Foster Engineering Co., Ltd., of Wimbledon, has opened a branch at 19, Barwick Street, Birmingham, and Mr. L. D. Gunnell, who has represented it in the Home Counties for some time, has been appointed branch manager. The Birmingham agency of the company has for many years been in the hands of Mr. A. Goldie Engholm, who has now relinquished the representation.

Messrs. R. Sell and L. G. Coade (Sell, Coade & Co., 190, Ashted Row, Birmingham), agents for the Park Royal Engineering Works, Ltd., Kelvin, Bottomley & Baird, Ltd., Royles, Ltd., &c., have dissolved partnership. Mr. Coade will continue the business under the style of L. G. Coade & Co., and has removed his office and showroom to 71, Temple Row, Birmingham.

Catalogues and Lists.—Messrs. H. W. Butler & Co., 41, Great Ormond Street, W.C.—An illustrated brochure (in French) describing tests made upon strings of various types of insulators made by the firm's principals, the Cie. Gen. d'Electro-Céramique.

The English Electric Co., Ltd., Queen's House, Kingsway, W.C.2.—A descriptive catalogue (Price List No. 1021) of slipring and squirrel cage motors. Fully illustrated and dimensioned.

The Underfeed Stoker Co., Ltd., Coventry House, South Place, E.C.2.—An illustrated description of the "Lopulco" system of pulverised fuel which is being installed for the Soc. An. Union d'Electricité, Paris.

Messrs. Hobdell, Way & Co., Ltd., 45, Church Street, Minories, E.1.—A report on the testing of insulating materials of the firm's manufacture by the National Physical Laboratory.

The Electric Construction Co., Ltd., Wolverhampton—An illustrated folder dealing with "E.C.C." small a.c. motors.

The Imperial Lighting Co., 2-6, Pocock Street, Blackfriars Road, S.E.1.—An illustrated catalogue of lighting fittings and other accessories for stage purposes. Fully priced.

Messrs. Beecroft & Partners, Ltd., St. Peter's Close, Sheffield.—Three circulars advertising ladle flux, "Corbeerite" powder for use in foundry work, and a metal-testing service.

Messrs. P. L. Dwyer & Co., 30, Grosvenor Place, S.W.1.—Three price lists dealing respectively with wires, cables, conduits, and accessories; radio sets and components; and "E.M.I." fans and small motors.

Messrs. Hyatt, Ltd., 56, Victoria Street, S.W.1.—A series of pamphlets giving load capacities at various speeds, fit allowances, &c., for ball and roller bearings.

The English Electric Co., Ltd., Queen's House, Kingsway, W.C.2.—An illustrated list (No. 1510) describing the use of small induction motors for driving textile machinery, &c.

Siemens & English Electric Lamp Co., Ltd., 38-39, Upper Thames Street, E.C.4.—Catalogue Z.100, illustrating and describing the "Zed" fuse system; and Price List No. 63, giving details of "Siemens" electric fans.

Messrs. S. Guiterman & Co., Ltd., 35 and 36, Aldermanbury, E.C.2.—An illustrated and priced pamphlet advertising the "Safe-Economy" iron.

The Crypto Electrical Co., Ltd., Acton Lane, Willesden, N.W.10.—Descriptive List 445, illustrating the "Crypto" commutating rectifier.

"Situations Vacant."—We have received the following communication from a "satisfied consumer":—

In connection with your "Situations Vacant" column, having heard many controversies upon its merits both at the bench and in the office, I have pleasure in stating my own personal experience, which I venture to suggest speaks for itself as to the utility of your most valuable journal.

Having had fifteen years' practical engineering experience, I should like to mention that I have secured all the posts I have held through the medium of your "Situations Vacant" column, which the attached statement will verify, classified under a general heading, and the actual appointments for your esteemed perusal, the latter, in the event of publication, to be regarded as private.

Furthermore, I have pleasure in enclosing herewith copies of two rejections which I have received recently from appointments advertised in one of your recent issues, to show the *bona-fides* of advertisements which appear under a "box-number."

The following is the list of appointments to which our correspondent refers:—

(1) Sub-station attendant,
(2) In charge of the test room at a dockyard.
(3) Electro-technical assistant to an instrument manufacturer.
(4) Draughtsman and test-room assistant to an electricity supply company.

Foreign Exhibitions.—Italy.—The London office of the Italian State Railways (12, Waterloo Place, S.W.1.) informs us that special reduced-rate tickets to Padua will be issued during the period of the International Samples Fair, which is being held during the first half of this month.

France.—A "white coal" exhibition is to be held at Grenoble in 1925. The town council of Grenoble, the local Chamber of Commerce, and a Committee are the organisers, and a sum of 1,000,000 fr. is to be expended on the scheme, which is to be raised, for the most part, by grants.

Industrial Electricity.—The Metropolitan Electric Supply Co., Ltd., is circulating amongst its power users and other interested persons, a profusely-illustrated brochure depicting the many industrial uses to which electricity may be applied. The pictures show cranes, lifts, machine tools, welding apparatus, dust extractors, printing machines, lighting installations, &c.

For Sale.—By order of the Marshal of the Admiralty and Prize Court, Messrs. Wheatley Kirk, Price & Co., invite offers for several cases of unused electrical plant and fittings lying at North Shields and Newcastle-on-Tyne. Bath Corporation Electricity Department has for disposal one 200-kW generating set. The Lancaster Corporation Electricity Department has for sale two 200-kW Belliss-Westinghouse d.c. generating sets and one 300-kW ditto ditto. (See our advertisement pages to-day.)

Portsmouth Corporation is inviting offers for the removal and purchase or removal only of an electrically-operated bascule bridge. The London County Council has for disposal the generating sets, boilers, coal conveyor, cooling tower, pumps, and water softening plant, at the London United Electric Tramways power station, Chiswick.

New Spanish-Belgium Company.—A new company has just been formed in Brussels (4, Rue Montoyer) with a capital of 1,750,000 fr., and the title La Société Hispano-Belge de Tramways et d'Electricité in connection with the extension of electric tramway and lighting undertakings in Spain.

Patent Restoration.—An Order has been made restoring Patent No. 6,496 of 1912, granted to Ricardo Gerardelli, for an electric motor for transmitting angular movements with an auxiliary motor, which controls the successive displacements for it.

Applications for British Trade Marks.—The following are included among the recent applications for British trade marks. Objections may be lodged within one month from the dates mentioned. In the case of foreign applications the names and addresses of the British representatives are also given.

Alinkin (lettering and design). No. 434,740. Electrical apparatus in Class 8. W. Price & Son, 29, The Strand, Southchurch, Southend. May 23rd, 1923.

Jeecophone. No. 434,756. Class 8. Apparatus for use in wireless telephony. The General Electric Co., Ltd., Magnet House, London, W.C. May 23rd, 1923.

Arcadian. No. 434,990. Class 8. Wireless telegraphy or telephony receiving sets. Baron & Coates, 3 and 5, Royal Arcade, Keighley. May 23rd, 1923.

Altraphar. No. 435,376. All electrical goods in Class 8. Edward J. V. Earle, trading as Vavasour Earle, Albany Wharf, Redhill Street, Regent's Park, London, N.W. May 23rd, 1923.

Kitchen-Aid (lettering and design). No. 430,161. Class 6. Electrically-driven beating and mixing machines. The Hobart Manufacturing Co., 711, Pennsylvania Avenue, Troy, O., U.S.A. (Haseltine, Lake & Co., 28, Southampton Buildings, London, W.C.). May 23rd, 1923.

Cooper-Hewitt. No. 425,288. Class 8. Mercury vapour electric lamps and mercury vapour current rectifiers. Hewittic Electrical Co., Ltd., 80, York Road, London, N. May 23rd, 1923.

Avometer. No. 427,638. Class 8. A combined instrument for measuring electric current, pressure, and resistance. Sydney H. Rawlings, 9, Victoria Street, S.W. May 23rd, 1923.

Lead.—Messrs. James Forster & Co., reporting on May 26th, state: "The premium on prompt lead has been maintained owing to short arrivals this month (totalling so far not more than 9,000 tons). It is also reported that 1,500 tons of lead have been sold for early shipment to Russia, and this, if correct, would account to some extent for the tightness of the May position. Demand from consumers continues quiet, and when the present period of stringency has passed there should be no lack of supplies for future requirements."

Wages in the Coal-Mining Industry.—Speaking on May 27th, Mr Frank Hodges (Secretary of the Miners' Federation) said that the abandonment of the existing agreement would not remedy the present state of affairs, by which miners in many districts were receiving extremely low wages. A strike would merely lead to even worse conditions. Two ways of improvement were opened, *viz.*, voluntary co-ordination among coal owners to eliminate the inequalities which now existed, or compulsory unification—either by nationalisation or a guaranteed wage, which would take account of the increased cost of living.

Book Notices.—"The Electrical Handling of Materials." Vol. IV, "Machinery and Methods." By H. H. Broughton, M.I.E.E. &c. (Pp. 334; 279 figs.) London: Benn Bros., Ltd. Price 50s. net.

"Science Abstracts." Sections A.—Physics; and B., Electrical Engineering. Vol. XXVI, Part 5, May. London: E. and F. N. Spon, Ltd. Price 3s. per section.

"The Practical Electrician's Pocket Book, 1923" (Pp. xci +571 and diary). London: S. Rentell & Co., Ltd. Price 3s. net.—We have to apologise for the lateness of this notice, owing to an oversight, but although five months of the year have gone we do not consider that this detracts from the value of this useful work which is now in its twenty-fifth year. Keeping pace with recent developments, a "broadcasting" section has been added, and the notes on electric heating and cooking have been augmented. The sections dealing with comparative resistances of various metals and alloys, steam boilers, motor control gear, portable electric tools, flexible wires and cables, and railway signalling have been re-written in the light of later inventions and investigations. The valuable portion giving particulars of the electricity supply undertakings of Great Britain and Ireland has also been brought up to date, which is in itself a heavy task.

"Senior Magnetism and Electricity," by R. H. Jude and J. Satterly. Second edition. Pp. viii+446; 260 figs. London: University Tutorial Press. Price 6s. 6d.

"Mining Electrician's Handbook," by L. Fokes. Pp. viii +414; illustrated. Wigan: Thomas Wall & Sons, Ltd. Price 10s. 6d.

The number of the *Architect*, which appears to-day, will be of interest to those aspiring to possess a bungalow or a small country house, as it contains photographs, designs and plans for over twenty examples, costing from £800 to £3,000.

"*Journal* of the Institution of Electrical Engineers." Vol. lxi. No. 318. May, 1923.—This issue contains the following:—"Permissible Current Loading of British Standard Impregnated Paped-insulated Electric Cables"; "Second Report on the Research on the Heating of Buried Cables"; "Report of the Council for 1922-23"; and "Annual Accounts of the Council for 1922."

"A.C. Protective Systems and Gear," by J. Henderson and C. W. Marshall. Pp. xii+108; 32 figs. London: Sir Isaac Pitman & Sons. Price 2s. 6d. net.

Local Exhibitions.—GLASGOW.—The Engineer and Manager of the Corporation electricity undertaking (Mr. R. B. Mitchell) has sent us a copy of the booklet printed in connection with the opening of four all-electric houses. The illustrations show these to be very tastefully equipped, and the text gives details of the cost of heating, cooking, baths, &c. About 1,000 people a day visited the houses while they were open for inspection.

PERTH.—The Duchess of Atholl opened a utility exhibition, containing 40 stalls, on May 23rd. Mackenzie Bros., electrical engineers, Perth, have three stalls, and among the exhibits are radio receiving sets, electric motors, irons, and heating and cooking appliances.

ILFORD.—An electrical exhibition was formally inaugurated at the Town Hall by Alderman G. Lee, chairman of the Council, under the auspices of the Electricity Committee, on May 29th. Councillor H. O'Dell, chairman of the Electricity Committee, who presided, stated that the committee was prepared to let out domestic appliances on the "hire-purchase" system. The stands were artistically arranged, the exhibits including cookers, heaters, washers, irons, kettles, suction-cleaners, boilers, geysers, &c. The following firms displayed a variety of appliances:—The General Electric Co., Ltd., the Hotpoint Electric Appliance Co., Ltd., Carron Company, Ajax Electrical Engineering Co., the British Electric Transformer Co., Ltd., the Jackson Electric Stove Co., Messrs. Belling and Co., Edgar C. Porter, W. H. Sugden and Ryland's Electrical Co. The Council also had a well-equipped stand.

The Norwegian Market.—*Commerce Reports* states that a good demand exists for power-plant equipment and supplies in the district around Bergen. In the districts of More, Sogn og Fjordene, and Hordaland there are 664 power stations, with an aggregate capacity of 279,885 kW. Although Sweden, England and the United States have supplied equipment German competition is becoming very acute. The more important undertakings are municipally owned, and purchases are made through local commission agents, or upon bids received from Norwegian representatives of foreign firms.

New French Companies.—There has been formed at Marseilles (18, Avenue Saint Gabriel), the Câblerie Phocéenne for the manufacture and sale of electric cables, bare and insulated. The capital is fixed at 1,800,000 fr.

The Société des Grands Travaux Electriques is the style of a company embodied at Paris (60, Rue de la Victoire), with a capital of 550,000 fr. in 500 fr. shares, fully subscribed.

La Société pour la Fabrication et Vente de Fils et Cables Electriques Nus et Isolés is the name of a new company which has lately been formed in Marseilles (18, Avenue St. Gabriel) with a capital of 1,820,000 fr., for the manufacture and sale of bare and insulated electrical wires and cables.

Australian Tariff Decisions.—The papers report that the following tariff decisions have been approved by the Customs Department:—Deferred Duties: The operation of the deferred duties on the undermentioned tariff items has been postponed to the date shown opposite each item: Item 152 (A) iron and steel tubes or pipes (except riveted, cast, close jointed, or cycle tubes or pipes), not more than 3 in. internal diameter, iron and steel boiler tubes, September 30th, 1923. Item 181 (B) (2), cables, telegraph and telephone, paper insulated, lead covered, July 1st, 1923.—*Reuter's Trade Service* (Melbourne).

United States Electrical Exports.—*Commerce Reports* states that, according to preliminary figures, exports of electrical goods from the United States during February amounted in value to $4,839,738. This was less than the previous month's total, but the shorter month accounts for the decrease. Among the items which showed increases were fractional horse-power motors, motors over 200 h.p., and domestic appliances. There were considerable decreases in the exports of mechanical-drive turbines, self-contained lighting sets, and telegraph apparatus.

Australia and Anti-Dumping.—The anti-dumping duties have been made retrospectively applicable to electric immersion heaters and magnetos.—*Reuter's Trade Service* (Melbourne).

A Belgian Company.—The Société d'Electricité et de Mécanique (Thomson-Houston & Carels systems) states that apart from the loss of production and of orders owing to a strike in 1922, the labour dispute also prevented the completion and invoicing of orders so that the turnover only represented 55 per cent. of that in 1921, this explaining the loss shown in the balance sheet. Competition had been and continued to be very keen not only on account of the decline in the transactions offering in Belgium, but also in consequence of the general economic crisis. The high level of exchange which brought about a corresponding increase in the cost of raw materials had caused an increase in the costs of production which was not fully equalised by the advance in sale prices. Business in countries which formed the company's chief markets had been seriously hampered by the raising of customs barriers, the depreciation of exchange or the exercise of a marked preference for national industries, but some compensation had been obtained in the home market. In the case of the company's subsidiary—the Manufacture Belge de Lampes Electriques—the production of Mazda "half-watt" lamps had been added to that of the "one-watt" lamps, and it was hoped to be able to develop so as to render the country independent of imports from abroad. The loss for the year is returned at 2,336,000 fr., the results of the strike not having permitted of the covering of the general expenses and financial charges.

Proposed Electrical Exhibition at Newport (Mon.).—The Corporation is inviting applications from firms who desire to take space at this exhibition. (See our advertisement pages to-day.)

Cable-making Industry J.I.C. — The Joint Industrial Council for the Electrical Cable-Making Industry has issued a second report upon the results achieved during the years 1921 and 1922. The report refers to the representation of the non-associated firms on the Council which has considerably strengthened that body; and to the representations made to the Government regarding the alleviation of unemployment, which were met in a great measure by the Trade Facilities Act, and the Electricity (Supply) Act, 1922. It is stated that the steps taken by the Council during the engineering lock-out of 1922 minimised unemployment among employés in the cable industry. To counteract foreign competition the existing wages agreement was modified and this, too, guarded against unemployment, as it became easier for British firms to secure contracts. Owing to the lack of disturbances in the cable-making industry it had been suggested that the Council was of little use, but the report states that the work of the period under review has justified the Council's existence, and "the attitude now appears to be that it is so useful that it may well be left to settle all questions arising without very active support or critical control."

Electrical Engineering in Poland.—In a report recently issued by the Department of Overseas Trade, Mr. R. E. Kimens, Commercial Secretary to H.M. Legation at Warsaw, says that the electrical engineering industry continued to develop satisfactorily during 1922. "The number of types of articles manufactured in Poland showed a decided increase over those given in last year's report. Telegraph and telephone apparatus, wireless equipment and transmission valves, cables, electric lamps, dynamos and motors, switchgear and household accessories are now being made. This large increase in the number of locally manufactured articles is in a great measure due to the depreciation of the Polish currency, which has rendered purchases abroad extremely difficult. The majority of the electrical apparatus sold on the Polish market, apart from the Polish productions mentioned above, is of German and Austrian origin. A Dutch concern has opened a lamp factory near Warsaw, and is considering the opening of a glass factory to manufacture the bulbs."

The Accessories Market in South Africa.—*The South African Mining & Engineering Journal* in a recent reference to the dulness of business in electrical goods made the following comments on the situation:—"The head of a leading electrical importing firm this week said people wanted things cheap nowadays, and the merchant had perforce to buy in the cheapest market. This market, Germany, had up to recently supplied what was wanted, more or less with satisfactory results as to quality and price; but, he stated, within the past three or four months Germany seemed to have gone to pieces absolutely. He instanced one particular line, tumbler switches, which in the past had been fairly satisfactory, but had now become absolutely worthless, and proved that the German market was finished, as far as Johannesburg was concerned with it. 'The market,' he said, 'is such a poor one, and the demand for cheap articles so great that one naturally turns to the Continent, and one gets taken down, as the quality of commodities recently received was very poor.' 'It is,' he thought, 'a great pity that the retailer who buys this rubbish should not be the person who is let down, but the merchants.' The whole tone of the electrical accessories market here is most depressing on that account."

A Pulverised Fuel Installation.—The Detroit Edison Co. has recently ordered six water-tube boilers, each of 325,000 lb. normal evaporation, to be fitted throughout with the "Lopulco" system of pulverised fuel firing, the European rights of which are controlled by the Underfeed Stoker Co., Ltd. The Detroit Edison Co., as is well-known, is one of the largest power users in the world, and as it has hitherto been an opponent of pulverised fuel this is another striking indication of the remarkable progress that is being made with this system of firing. These new boilers will dispute with the boilers now under construction for the Cleveland Electricity Co., also to be fitted with the "Lopulco" pulverised fuel system, the distinction of being the largest boilers in the world. In Europe the record is at present held by the 160,000-lb. boilers being constructed for Vitry, in France, and in Great Britain the largest unit is of 100,000-lb. capacity.

The Orient's Advantage.—Commenting in a recent issue upon the remarkable electrical developments which are distinguishing China and Japan, *Eastern Engineering* points out that many Oriental towns are now electrically equipped where British towns of much greater size and importance are still compelled to use gas or a "patchwork" system of gas and electricity. This is almost entirely due to the fact that in the Far East the engineers are able to begin with a clean sheet, whereas in this country other than electrical interests already hold the field, making the growth of electricity a slow process. "In this respect the Far East is at a great advantage, as its development can be hastened and made more sure by the employment of the very latest applications of industrial and engineering science unhampered by the shackles of older systems."

Forthcoming Exhibitions.—The following exhibitions are being organised:—

LONDON.—August 31st to September 22nd, Shipping, Engineering, and Machinery Exhibition; September 8th to 14th, Bakers' Exhibition; October 15th to 20th, Motor-Cycle and Cycle Show; November 22nd to December 1st, Motor Exhibition.

CANADA (*Toronto*).—August 25th to September 8th, Canadian National Exhibition.

CZECHO-SLOVAKIA (*Prague*).—September 2nd to 9th, International Samples Fair.

BELGIUM (*Namur*).—September 1st to 17th, Commercial Fair.

FINLAND (*Helsingfors*).—July 1st to 7th, International Samples Fair.

ITALY (*Turin*).—September 8th to 30th, Patents and Industrial Improvements Exhibition. (*Naples*).—September 16th to 30th, International Industries Fair.

JAVA (*Bandoeng*).—July 28th to August 12th. Trade Fair.

JUGO-SLAVIA (*Ljubljana*).—September 1st to 10th, International Trade Fair.

LATVIA (*Riga*).—July 22nd to August 5th, Industrial and Agricultural Exhibition.

MADAGASCAR (*Antananarivo*).—August 15th to September 15, International Commercial Fair.

NORWAY (*Christiania*).—September 2nd to 9th, Samples Fair.

RUSSIA (*Moscow*).—August-September, Agricultural Exhibition and Fair.

SPAIN (*San Sebastian*).—July to September, Samples Fair.

SWEDEN (*Gothenburg*).—August 20th to 21st, Trade Fair.

TRIESTE.—September 3rd to 24th, International Samples Fair.

URUGUAY (*Montevideo*).—December, Industries Exhibition.

Contractors and the E.D.A.—The Electrical Contractors' Association has now decided to make a joint subscription on behalf of the whole of its members to the funds of the British Electrical Development Association. This valuable addition to E.D.A. support will undoubtedly secure wider activity in the provinces, assist the Association in building up district sub-committees, and greatly increase the interest of all contractors in the work of their representatives on the E.D.A. Council and committees.

The latest E.D.A. pamphlet (No. 368) instructs consumers to ask for British Standard connections when ordering appliances and fittings, to enable additions to be made easily.

The Boilermakers and the Federation.—The Federation of Engineering and Shipbuilding Trades has decided to hold a meeting of representatives of its constituent unions to consider the re-organisation rendered necessary by the expulsion of the Boilermakers' Society. The *Daily Herald* states that there is a general opinion that the reconstructed Federation should include the A.E.U. and the Foundry Workers. The Boilermakers' Society has asked for a meeting with representatives of the Shipbuilding Employers' Federation to discuss the present lock-out, and the Federation has agreed to this.

Vickers's Annual Meeting.—In the course of his speech at the annual meeting on May 24th, Mr. Douglas Vickers (chairman) said that the working arrangement recently concluded with the Spearing Boiler Co. would put Vickers, Ltd., in the position of being able to completely equip a power station from the boilers to the turbines and generators, and the switchboards and cables.

Last July he (the chairman) had expressed the view that the clouds were lifting, for there were distinct signs of an industrial revival. Unfortunately, just at that time the French occupation of the Ruhr began, and the demand for British coal and steel had forced the prices up, which frightened the buyers of finished productions and killed demand. Coal and coke companies had gained a passing advantage, but, on the whole, the French occupation of the Ruhr was causing a considerable loss to the engineering trades of this country.

Sterling Publicity.—The Sterling Telephone and Electric Co., Ltd., has secured the exclusive permission of the British National Opera Co. to utilise the photographs of the principal members of the latter company in operatic *rôles* for the purposes of a booklet advertising the Sterling Co.'s radio apparatus. The appliances illustrated are all priced.

To encourage the sale of its radio receiving sets and "Magnavox" loud speakers the company is offering to its agents an attractive glass window tablet, picture postcards, and publicity matter overprinted with the agents' names and addresses.

Trade with China.—Mr. F. R. Eldridge, Chief of the Far Eastern Division of the U.S. Department of Commerce, states that Chinese merchants prefer to deal with foreign firms who are on the spot and with whom they are well acquainted. "Generally speaking, unless the American manufacturer is prepared to spend considerable money in making a close investigation of China, its resources, and the needs of the people, and unless the procurable business is sufficient to warrant establishing his own selling forces in China, it would prove more profitable at present to sell his goods to the representative American agent of the native merchants. The mere canvass of a territory and the placing of agencies with various local concerns, without personal representation, is not sufficient in dealing with China.

"The policy usually followed by the American manufacturer who does not wish to establish selling offices in China at once is the placing of an agency with one of the large American importing and exporting houses in Shanghai. Such a firm, with its numerous branches throughout the country, is in a position to obtain the distribution of any commodity marketable in China, provided the agent receives the full support of the manufacturer in the United States."

Chinese Notes.—The China Electric Co. is now installing a wireless telephone system between Peking and Tientsin. The company has an understanding with the Ministry of Communications, that if the project proves successful it will sell the system to the Ministry.

The application made by the Jehol Telephone Co. for registration has been granted by the Ministry of Communications, which has also issued a business licence to the company.

To provide for extension, the Wu Hsing City Electric Co., in Huchow, Chekiang, has increased its capital by issuing new shares to the amount of $70,000, which makes the total capital $120,000. The company was formerly known as the Wu Hsing City Electric Light Co., and its business was confined to the supplying of electric light to the city. With the increase of its capital it has adopted the present name and is undertaking the supply of electric power to the public. The company's request for registration has been granted by the Ministry of Communications.

LIGHTING AND POWER NOTES.

Barnsley.—Year's Working.—The report of the borough electrical engineer (Major E. A. Barker) on the working of the electricity undertaking for the year ended March 31st last shows a total revenue of £48,625. Working expenses amounted to £24,077, leaving a gross profit of £24,548. After deducting interest, sinking fund charges, &c., there was a net profit of £8,941. The number of kWh sold was 4,008,098, an increase of 20 per cent. on the previous year and the cost per kWh generated was 2.37d.

Brandon.—Hydro-Electric Scheme.—The Rural Council has received a communication from Thetford Town Council with regard to a suggested hydro-electricity scheme for lighting Thetford and Brandon, and a consulting engineer (Mr. R. H. L. Lee) has been appointed to report on the matter.

Bexhill.—New Power Station.—The Town Council has received the sanction of the Electricity Commissioners to the erection of a power station at Little Common.

Birmingham.—Year's Working.—As foreshadowed, the Electric Supply Committee is in a position to report a record surplus, to make a contribution to the relief of rates, and again to reduce the charges for electricity. Ald. J. B. Burman, who presided at a meeting of the committee on May 23rd, reported that the annual accounts showed a record surplus of £107,000, of which £12,500 would go to the borough rate. It was proposed to transfer £70,000 to renewals and special expenditure account and the balance of £26,000 to the reserve fund. In view of the satisfactory results of the trading during the past year the committee has also recommended the Council to reduce the tariff of charges from the June quarter readings. The reductions vary from ½d. to ¼d. per kWh according to the class of supply, and are estimated to amount in the aggregate to a sum of £96,000. The change brings the initial price down from 5½d. to 5d. per unit and makes the third reduction during a period of fifteen months.

Blackrod.—Electricity Supply.—The Urban District Council has under consideration a proposal to obtain an electricity supply for the district and has applied to the Bolton Corporation for terms upon which it would be willing to give a supply.

Bredbury and Romiley.—Electricity Supply.—The Urban District Council has under consideration a proposal to obtain a bulk supply of electricity from Stockport, and a canvass is to be made of the residents to ascertain how many would be willing to take a supply.

Chester.—Loan.—The City Council is applying to the Electricity Commissioners for sanction to the borrowing of £37,000 in connection with the extension of the electricity supply to the area for which a Special Order has recently been obtained. The following charges for electricity for power have been arranged for the new area: (1) A fixed charge not exceeding 2s. 6d. per quarter per h.p. connected. (2) A unit charge not exceeding 2½d. per kWh for the first 1,000 kWh per quarter, 2¼d. per kWh for the second 1,000 kWh per quarter, 2d. per kWh for the third 1,000 kWh per quarter, 1¾d. per kWh for the fourth 1,000 kWh per quarter, and 1½d. per kWh for all electrical energy in excess of this amount.

Clacton.—Year's Working.—The accounts of the Council's electricity undertaking (engineer: Mr. G. Broadhurst) for the year ended March 31st last show a total revenue of £12,496, as against £10,623 in the previous year. Working expenditure amounted to £4,322, as compared with £5,229, leaving a gross profit of £8,174 (£5,394). After the payment of capital charges, charges for plant purchased from revenue, &c., a net profit of £3,078 remained. This, together with a profit of £302 brought forward, making £3,380, was carried forward. The number of kWh sold was 371,989, as compared with 279,114 kWh in the previous year.

Continental.—France.—The electrification of the rural districts of the Ardennes has been advanced a practical stage by the issue of an *arrêt* of the Préfet, authorising the formation of a syndicate for the purpose. The scheme embraces 74 communes.

The Electrical Control Board of the Haute Marne Department is preparing a scheme for the electrification of 584 communes in the department. The approximate length of the h.p. lines to be erected is 1,392 km., and of the l.p. lines 669 km. The scheme will take 15 years to complete and the estimated cost is 26,000,000 fr.

Belgium.—A new 3,000-kW turbo-generating set has recently been installed at the generating station connected with the works and collieries of the Société des Charbonnages, Hauts Fourneaux et Usines de Strepy-Bracquegnies. The plant has now a capacity of 6,500 kW.

Russia.—Cancelling the decree of February, 1921, prohibiting the employment of electrical apparatus for heating dwellings, food, and other domestic non-reproductive uses, the authorities, it is now decreed, may grant permission to local power stations to supply current for the purposes indicated.

Reports from the country show that electrification is proceeding, and many share companies are taking part in the movement, as at Perm, Yaroslavl, Ekaterinburg, in the Tartar Republic, &c. The Karan Electricity Co. will complete the equipment of the second town electric station of 1,000 kW by November, so that the obsolete No. 1 electric town and tramway station can be closed. A bureau has been formed in Perm to organise a local company for electrification with a capital of 50,000 gold roubles.

A company has been formed in Ekaterinburg, with a capital of 2,000,000 roubles, to construct and exploit a power station by the peat marsh for the Verch Isset factory. Here, too, many villages will be supplied with current. Thus town and village linking is becoming more general, as in the Governments of Tula, Simbirsk, &c.

Coventry.—Electricity Extensions.—The Corporation is extending the Sandy Lane power station at a cost of £44,188.

Dundee.—Change-over.—The Town Council has decided to change the system of supply in the Cults area from direct to alternating current, at an estimated cost of £8,000.

Hornsey.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £27,250 for the purchase of land and the erection of a substation.

Huddersfield.—Inquiry.—On May 23rd, Col. T. C. Ekin opened an inquiry on behalf of the Electricity Commissioners into the conflicting applications of the Huddersfield Corporation and the Electrical Distribution of Yorkshire, Ltd., for powers to supply electricity to Marsden, Lepton, Kirkburton, Kirkheaton, Slaithwaite, and Melton. Messrs. A. T. Miller, K.C., and J. W. Turner (borough electrical engineer), giving evidence in support of the Corporation's application, said that the supplying of these districts was a natural extension of the Corporation's undertaking. The latter had been a financial success, and the charge for lighting was 4½d. per kWh, with an addition of 10 per cent. for certain outlying districts. The supply to the districts in question would be given on the same footing, and although there might be a loss for a year or two the proposals would eventually be remunerative.

Mr. J. D. Eaton Smith, who was instructed by all the local councils concerned, with the exception of Marsden, expressed approval of the Corporation's application.

Mr. T. W. Broadbent stated that he had supplied electricity to Kirkheaton and Lepton for 26 years, and asked that whatever decision was arrived at his rights might be protected.

When the inquiry was resumed on the following day Mr.

Turner stated that the extension of mains would cost the Corporation £34,000. He was not surprised that mains from the company's sub-stations would only cost £8,000. Counsel for the company intimated that his clients desired time to go into the figures put forward by the Corporation, and the Inspector accordingly adjourned the inquiry until June 8th.

Ipswich.—Electricity Supply.—In order to meet the increased demand for electricity the Town Council has decided to lay a ring main round the outskirts of the town. The first portion of the scheme will be carried out during this summer at a cost of £4,500. It is proposed that the central portion of the town should be reserved for d.c. supply and that the supply to the residential portions outside the central area should be gradually changed over to a.c.

Irish Free State.—Clogher (Co. Tyrone).—At a recent public meeting it was proposed to introduce an electricity supply for the town, and a committee was appointed to obtain the advice of a consulting engineer and report.

Bagenalstown (Co. Carlow).—The local traders, with the co-operation of the residents, have decided to light the town by electricity. A power station will be erected on the canal bank near the town. The estimated cost of the scheme is £5,000.

Leeds.—Year's Working.—The report of the engineer and manager of the municipal electricity undertaking (Mr. C. Nelson Hefford) for the year ended March 31st last records a total revenue from all sources of £525,767, as compared with £508,542 in the preceding year. Working expenses amounted to £175,450, as against £248,785, leaving a gross profit of £350,317 (£259,757). Capital charges absorbed £215,381, as compared with £183,162; the net profit was therefore £134,935, as against £76,595. From this surplus £97,237 has been contributed to the cost of permanent works; in 1921-22 £49,704 was allocated to this purpose. Thus, the final surplus amounted to £37,698 (£26,891).

The capital account shows a total expenditure of £3,221,834; against this £1,404,773 has been set aside, leaving a net indebtedness of £1,817,061. The total amount of energy sold during the year was 71,937,148 kWh, an increase of 22.29 per cent. upon the previous year's sales. The cost per kWh sold (including capital charges) fell from 1.96d. to 1.62d., and the average price obtained from 2.07d. to 1.75d. The number of consumers connected rose from 25,616 to 30,097, the connected load from 99,113 kW to 109,583 kW, and the maximum demand from 30,830 kW to 36,400 kW. The capacity of the station remained at 51,000 kW, owing to the delay in the completion of the 12,000-kW turbo-alternator. The sanction of the Electricity Commissioners has been received for the replacement of two 3,000-kW turbo-alternators by a 10,000-kW set, and also for the installation of an additional 12,000-kW set, together with boilers, switchgear, &c. The capacity of the station will thus be raised to 79,000 kW.

Paisley.—Electricity in Bulk.—The Corporation has received two offers of a bulk supply of electricity, one from the Glasgow Corporation and the other from Greenock, Kilmarnock, and the Clyde Valley Electric Power Co., Ltd., jointly, and has decided to accept the latter offer. A committee has been appointed to enter into an agreement.

Palestine.—The Rutenberg Concession.—It is reported that so far Mr. Rutenberg has not commenced to develop the water powers of the country under the terms of his concession, but has erected a power station near Jaffa. It appears probable that this will be unsuccessful, as the bulk of the population of Jaffa is Christian or Moslem, and has adopted an attitude of hostility to the scheme, which is regarded as a Jewish political project.

Price Reductions.—Reductions in the charges for electricity have been made in the following districts:—

Liverpool.—Lighting: Flat rate; 5.95d. per kWh to 5.25d. Power: Flat rate; 3d. per kWh. to 2¼d. Maximum demand scale: The war percentage increase from 70 to 50 per cent. Rateable value scale: (Private houses) 10 per cent. on rateable value, plus 20 per cent. and 1d. per kWh., plus 50 per cent.; (business premises), 14 per cent. on rateable value, plus 20 per cent. and 1d. per kWh. plus 50 per cent. A new scale has been introduced to encourage the use of domestic appliances (private houses only): 25 per cent. on rateable value plus ½d. per kWh.

Waterloo-with-Seaforth and Great Crosby.—Lighting: percentage increase from 70 per cent. to 50 per cent. plus 1½d. per kWh. Shop lighting: percentage increase reduced from 35 per cent. to 25 per cent. Power: percentage increase reduced from 25 per cent. to 12½ per cent.

Redditch.—Transfer of Undertaking.—The Urban Council has sealed an agreement with the Shropshire, Staffordshire, and Worcestershire Electric Power Co., transferring its electricity undertaking to the company.

Stratford-on-Avon.—Electricity Supply.—The Barford Electric Supply Co. is applying to the Electricity Commissioners for consent to erect overhead lines for supplying electricity to the villages of Walton, Wellesbourne, Combroke, Kineton, Charlecote, Hampton Lucy, Tiddington, and Alveston. The company proposes to increase its generating plant. The Rural Council, whose area is affected by the scheme, has referred the matter for a report to its Highways and Finance Committee.

United States.—In a recent issue of the *N.E.L.A. Bulletin* a comparison is made between the electricity supply industry and other great industries of the United States. The capital invested in power undertakings is placed at $5,000,000,000 and the annual revenue at $1,000,000,000. This is only surpassed by the railways, which have a capitalisation of $20,000,000,000 and annual earnings of $2,750,000,000. The gas industry has a capitalisation of $2,500,000,000 and an annual revenue of $600,000,000.

Aluminium Cable.—The Ohio Public Service Corporation is erecting a length of 380 miles of steel-cored aluminium cable in the north-east portion of the State. The total weight is stated to be about 500 tons.

Uruguay.—Relaxation of State Monopoly.—The Government has introduced a Bill into the legislature amending the law creating a State monopoly of electricity supply. This will enable "precarious" concessions to be granted, *i.e.*, concessions liable to withdrawal at any time.

Wantage.—Electricity Supply.—The Urban Council has decided to consent to the application by the Western Electric Distributing Corporation, Ltd., for an Order to supply electricity to the town.

TRAMWAY AND RAILWAY NOTES.

Belfast.—Track Renewals.—The City Council is to proceed with the reconstruction of the third section of the tramway track at a cost of £205,349. The contract for the work has been placed with Mr. M. A. Boswell, of Wolverhampton.

Continental.—Italy.—The Ministry of Public Works has allotted 180,000,000 lire in the Budget for State railway construction, as follows:—Cuneo to Ventimiglia, 7,000,000; Fossano to Mondovi and Ceva, 5,200,000; Veneto railway, 46,000,000; Poggio Rusco to Verona, 2,000,000; Bologna to Florence, 40,000,000; Aula to Lucca, 12,800,000; Sant' Arcangelo to Urbino, 11,000,000; lines in vicinity of Rome, 3,000,000; Rome to Naples, 36,000,000.

Huddersfield.—Year's Working.—The report on the working of the tramway undertaking for the past year shows a total income of £289,980. Working expenses amounted to £217,616, leaving a gross surplus of £72,364. After payment of interest, income tax, &c., there was a net profit of £15,913.

Keighley.—Railless-Car System.—The Town Council has decided to substitute railless cars in place of the present tramway system, owing to the high cost which would be involved in the renewal of tramway track.

Year's Working.—The report on the working of the tramway undertaking for the past year shows a net profit of £1,604, and the railless-car system shows a deficit of £1,710.

United States.—New Electric Railway.—*Electric Traction* (Chicago) reports that application has been made to the Inter-State Commerce Commission for sanction to the construction of a new electric railway, over 1,300 miles in length, to serve the states of Arizona, Colorado, California, and New Mexico. A capital of $40,000,000 has been subscribed, and the work will be commenced as soon as formal permission is obtained. It is proposed to employ the overhead system and to erect two separate power stations, one of 62,500-kW capacity and the other of 32,000 kW. The erection of a number of sub-stations, with a total of 256,000 kW of plant, is planned. The rolling stock will include thirty 300-ton, eight 190-ton, and six 80-ton locomotives. One interesting point in the scheme is the use of regenerative braking on a gradient 96 miles long, descending from an altitude of 7,190 ft. to 2,938 ft. The maximum fall is 2½ per cent. for a few miles.

TELEGRAPH & TELEPHONE NOTES.

France.—Underground Telephone Cables.—Among the subjects discussed at the conferences during the electrical week early in May was the introduction into France of underground telephone cables. According to M. Legouez, president of the Union des Syndicats de l'Electricité, the substitution of telephone cables for overhead lines would allow of a traffic of 20,000 messages a day instead of 5,000, as at present. It would reduce the cost while bettering the quality and speed of the service. The total outlay of the first installation is reckoned at 100,000,000 fr., as against 123,000,000 fr. for a like number of ordinary circuits. By existing circuits the net cost of messages is 7.15 fr., whereas it would be only 4.70 fr. by the projected cable. A programme drafted by the Sous-Secrétaire d'Etat proposed the creation of (1) inter-regional circuits linking Paris and 20 of the principal cities of France; (2) circuits linking the regional centres and the departmental centres; (3) circuits linking the departmental centres with Paris; and (4) circuits linking the departmental centres together. The total length of the circuits to be set up, according to this plan, would be 375,000 km., or about

2,500 km. of cables. At present prices of material, the cable would cease to be advantageous where the artery contains less than 10 to 15 pairs of lines. It is added that Sweden will shortly possess 1,800 km. of cables, Japan 2,800, Switzerland has already 600, and Belgium 160 km., while the multiple telephone system in the United States is already applied to 7,500 km. of telephone circuit and 125,000 km. of telegraph circuit.

Greece.—TELEPHONE RECONSTRUCTION.—Proposals have been made by a Belgian telephone manufacturing concern, called "New Antwerp," for the reconstruction of the Greek telephone system. The cost of the work is given at 65,000,000 drachmas, and the work is to be completed within two years after contracts have been signed. The proposals provide for the conversion of the present overhead lines to an underground cable system, with modern exchanges and the linking of Athens, Piræus, and Salonika, together with points in the interior, into a unified system.—*Commerce Reports.*

New Atlantic Cable.—Mr. C. H. Mackay, president of the Postal Telegraph Commercial Cables System, announced on May 6th that his companies had completed contracts for laying a new cable in the Atlantic Ocean to operate directly between New York and London. The new cable will be the first to be laid in the Atlantic between America and Europe since 1910, is now being manufactured by the Telegraph Construction and Maintenance Co. and Messrs. Siemens Bros., and will be laid by August 1st. Its speed will be approximately 600 letters per minute in both directions simultaneously, or a total of 1,200 letters in a minute, its conductor requiring an average of about 1,100 lb. of copper per mile.

The route of the new cable will be from New York to Nova Scotia, a distance of about 1,000 miles, and from Nova Scotia to the Azores, approximately 1,750 miles, where it will connect with a cable, already laid, to Waterville, Ireland, which in turn will connect with a new cable of 320 miles, also to be laid this summer, from Ireland to England. Still another cable will be laid from the Azores to the Continent of Europe in the near future.—*T. & T. Age.*

The Telephone Service.—NEW EXCHANGES.—A new telephone exchange was opened on May 28th at Eastbourne by the Mayor, who made the first call over the trunk line to London. Another exchange was opened in the Croydon district the previous week.

RADIO-TELEGRAPHY AND TELEPHONY.

Australia.—ST. PAUL'S ISLAND RADIO STATION.—The Dominion Government is to proceed at once with the erection of a radio station on St. Paul's Island, at the entrance to the Gulf of St. Lawrence, 25 miles from Cape North, Cape Breton Island, with which it is connected by cable.—*Reuter's Trade Service* (North Sydney, N.S.).

Czecho-Slovakia.—NEW RADIO STATION.—A beginning has been made with the building of the biggest radio station in the Republic. It is situated near the Podiebrand bathing resort, within the flood area of the Elbe, so that good earthing will always be assured. The antennæ are to be 100 metres high. The station is being built for direct communication with all the countries of Europe and with North America.

Irish Free State.—RADIO-BROADCASTING PROPOSALS.—A number of business men, who propose to erect a broadcasting station in or near Dublin, were in conference with the Irish Free State Post Office authorities at Dublin Castle last week on the question of licences for broadcasting and receiving apparatus. At present the public use of wireless is forbidden in the Free State. If the negotiations result favourably, a company will be formed in Dublin.—*Financial News.*

Radio-Broadcasting.—2 L O REMOVAL.—The London transmitting station of the British Broadcasting Co., Ltd., is to be moved from Marconi House to a new site in Wardour Street, W.—*Daily Mail.*

Russia.—NEW RADIO STATION.—A radio station is to be erected on Novaya Zemlya Island by the Russian authorities. It will be situated by Matochkin Strait and will be in communication with North Russian and Siberian stations.—*The Times.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

OPEN.

Aberdare.—June 7th. Electricity and Tramways Department. One 3-ton end-tipping electric lorry and a motor-generator charging set and control gear. (May 18th.)

Australia.—MELBOURNE.—August 31st. Electricity Commissioners. Aluminium steel-cored cable. (May 25th.)

NEWCASTLE (N.S.W.).—July 26th. City Council. H.p. switch and control gear, &c., for the electricity works.*

SYDNEY.—November 19th. City Council. Storage batteries, regulating switches, copper connections, charging boosters, and switchgear (spec. 736). Spec. (21s.) from the City Treasury, Town Hall, Sydney.

July 2nd. Vacuum tungsten and carbon-filament electric lamps.*

June 18th. 18,000 gallons of transformer oil.*

BRISBANE.—July 31st. Postmaster-General's Department. Cable terminals.*

Barnes.—June 11th. Urban District Council. One electrically-propelled dust-collecting van. Mr. G. B. Tomes, Engineer and Surveyor, Council Offices, High Street, Mortlake, S.W.14.

Barrowford.—June 5th. Urban District Council. Centrifugal pump, capacity 15,000 gallons per hour against a total head of 27 ft., a vacuum pump, motors, valves, wiring, switchgear, &c., for Wheatley Carr sewage works. C. J. Lomax and Son, civil engineers, 37, Cross Street, Manchester.

Belgium.—June 29th. Municipal authorities of Brussels. Installation of a cinder transporter at municipal electricity generating station at Quai des Usines, Brussels. Specifications (8 fr.) from 11, Rue Ste. Catherine, Brussels.

June 15th. Municipal authorities of Diepenbeek (Province of Limbourg). Establishment of a l.p. electricity distribution system in the town.

June 7th. Directeur de l'Aeronautique Militaire, 75, Rue de Commerce, Brussels. Nine 220-volt electric motors ranging from ¼ to 15 h.p.

June 15th. Turbo-alternators for the central electric station, 16, Quai des Usines, Brussels. Particulars, 11, Rue St. Catherine, Brussels.

Bristol.—July 2nd. Docks Committee. Two 2-ton movable electric jib cranes. Mr. T. A. Peace, Chief Engineer's Office, Avonmouth Docks, Bristol.

Coventry.—Rover Co., Ltd. Tenders for lighting sets (dynamos, accumulators, two side and one tail lamps, wiring and switchbox) and magnetos. Schedules from the Rover Co., Ltd., Coventry.

Croydon.—June 6th. Electricity Department. Coal (approx. 4,000 tons). (May 25th.)

Dublin.—June 5th. Dublin United Tramways Co. (1896), Ltd. Stores for six months (including electric lamps, fittings, &c.). (May 25th.)

Epsom.—June 12th. Electricity Department. One 200-kW d.c. generator, direct-coupled to a 300-h.p. heavy oil engine; feeder and pilot cables, feeder pillars and joint boxes. (See this issue.)

Falkirk.—Electricity Department. One 2,000-kW turbo-alternator, with condensing plant and accessories. (May 18th.)

France.—PARIS.—June 20th. Transformer sub-station at the Lisieux station. Particulars, Service Electrique, 43, Rue de Rome, Paris.

Greece.—ATHENS.—October 1st. Hydro-electric installation at Vladovo. Particulars, Office National du Commerce Extérieur, 22, Avenue Victor Emmanuel, Paris.

India.—BOMBAY.—June 28th. Great Indian Peninsula Railway Co. Electrification of Bombay suburban lines. Motor bogie trucks and bonds. (May 18th.)

Kendal.—June 14th. Electricity Department. Overhead l.p. transmission line. (See this issue.)

Leeds.—July 2nd. Electricity Department. Single-phase and 3-phase, Scott-connected transformers. (See this issue.)

Leicester.—June 23rd. Electricity Department. One 12,500-kW, 3-phase turbo-alternator, with condensing plant, and one 500-kW house service turbo-alternator. (May 25th.)

London.—L.C.C.—June 11th. L.p. electric cables (including telephone and pilot cables) and relaying and jointing existing l.p. cables. (May 18th.)

FULHAM.—June 6th. Electricity Department. 500 single-phase house service meters. (See this issue.)

INDIA STORE DEPARTMENT.—June 8th. Electric cables. (May 18th.)

June 15th V.i.r. copper wire. (May 25th.)

Manchester.—June 12th. Tramways Committee. Sand-drying apparatus. Mr. H. Mattinson, general manager, Corporation tramways, 55, Piccadilly.

Electric lighting of club premises. Steward, A.E.U. Club and Institute, Ltd., Toxteth Street, Higher Openshaw, Manchester.

June 6th. Electricity Committee. Stores for six months.

June 9th. Pressure testing equipment. Mr. F. E. Hughes, Electricity Department, Town Hall.

Morocco.—RABAT.—July 10th. 40,000 porcelain insulators of special pattern. Particulars, Office du Protectorat au Maroc, 21, Rue des Pyramides, Paris.

Newcastle-on-Tyne.—June 8th. Electricity Department. One 500-kW rotary converter, with e.h.p. and l.p. switchgear. (May 25th.)

New Zealand.—WELLINGTON.—July 31st. Public Works Department. Metering equipment in connection with the Lake Coleridge power scheme.*

July 31st. Oscillator testing set for the Mangahao power scheme.*

AUCKLAND.—June 28th. City Council. 1,460 tons of rails, with accessories. Specifications may be inspected at Messrs. Downie Bros., 7, Fenchurch Avenue, E.C.—*Reuter's Trade Service* (Auckland).

Nottingham.—June 14th. Electricity Committee. General stores for 12 months. Electrical engineer, Talbot Street.

Salford.—June 5th. Board of Guardians. Electrician's work, rewiring certain wards, Union Infirmary, Hope, Pendleton. Mr. E. H. Inchley, clerk to Board of Guardians, Poor Law Offices, Eccles New Road, Salford.

South Africa.—PRETORIA.—June 27th. Irrigation Department. 50-h.p. hydro-electric plant for the Hartebeestpoost irrigation works.*

RIVERSDALE (CAPE PROVINCE).—July 31st. Municipal Council. Generating plant, l.p. distribution material, meters, &c.*

JOHANNESBURG.—June 4th. Municipal Council. Electric wire and cable and transformers.*

WORCESTER (CAPE PROVINCE).—August 2nd. City Council. Additional generating plant for the power station.*

Southend-on-Sea.—Light Railways and Electric Lighting Department. One steel surface tramcar traverser, one tower wagon (petrol or electrically driven), 10,000 tons of coal. (See this issue.)

Spain.—MADRID.—June 5th. General Post Office. Telephone materials, carbons, &c. Tenders from British firms will be considered only in respect of such material as is not manufactured in Spain.*

June 12th. Direccion General de Correos y Telégrafos (Seccion de Telégrafos). Galvanised iron wire for the telegraphic and telephonic systems:—30 tons, 4 mm.; 30 tons, 3 mm.; 20 tons, 2 mm.

July 2nd. Direccion General de Obras Públicas, Ministerio de Fomento, Madrid. Electric locomotives and installation of cable for the line from Ripoll to Ax-les-Thermes, one of the trans-Pyrennean lines now being constructed.

Uruguay.—MONTEVIDEO.—July 12th. State Electric Light Works. General stores.*

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Brazil.—The Brazilian Hydro-Electric Co., Ltd., a subsidiary of the Brazilian Traction, Light and Power Co., Ltd., of Rio de Janeiro and Sao Paulo, has ordered from the Westinghouse Electric and Manufacturing Co. seven power transformers and a large amount of switching equipment for a new plant located on the Parahyba River, about 100 miles north-east of Rio de Janeiro. The power from this plant will be fed into the existing system of the Rio de Janeiro Tramway, Light and Power Co., Ltd., which is another subsidiary of the Brazilian Traction, Light and Power Co.

Carnarvon.—Corporation. Accepted:—

Extension of plant at the electricity works in connection with the additional bulk supply from the North Wales Power Co. (£6,345).—National Electric Construction Co., Ltd.

Chester.—City Council. Accepted:—

Switchgear in connection with the supply of electricity from Queen's Ferry (£685).—Metropolitan-Vickers Electrical Co., Ltd.

Glasgow.—Electricity Committee. Recommended:—

Three 1,875-kVA transformers and 2 evaporators for the Dalmarnock power station.—British Electric Transformer Co. (£3,883) for the transformers; and G. & J. Weir (£1,975) for the evaporators.

Extension of Byres Road sub-station (£1,273).—Wm. Taylor & Son (Glasgow), Ltd.

Twelve months' stores. Recommended:—

Cast-iron boxes, section pillars, &c.—James Allan, Senr., & Son, Ltd.; Carron Iron Co.; Falkirk Iron Co.; McDowall, Steven & Co., Ltd.; Robert Taylor & Co.

Malleable iron tubes and fittings.—Dempster, Moore & Co., Ltd.

Single lead-sheathed and insulated cable.—Enfield Ediswan Cable Works, Ltd.

Concentric and triple concentric insulated cables.—Callender's Cable and Construction Co., Ltd.

Telephone cables.—Callender's Cable and Construction Co., Ltd.

L.p., 600-volt, 2-core insulated cables.—Enfield Ediswan Cable Works, Ltd.; Callender's Cable and Construction Co., Ltd.

L.p., ditto ditto, 3-core.—Callender's Cable and Construction Co., Ltd.

Ditto ditto, 4-core.—Enfield Ediswan Cable Works, Ltd.; Callender's Cable and Construction Co., Ltd.

E.h.p. cables.—W. T. Glover & Co., Ltd.; Callender's Cable and Construction Co., Ltd.

Rubber-covered cables.—Craigpark Electric Cable Co.

Flexible cables.—Enfield Ediswan Cable Works, Ltd.

D.c. ampere-hour meters.—Edison Swan Electric Co., Ltd.; Chamberlain and Hookham, Ltd.; Ferranti, Ltd.

D.c. watt-hour meters.—Edison Swan Electric Co., Ltd.

A.c. meters.—Edison Swan Electric Co., Ltd.; Metropolitan-Vickers Electrical Co., Ltd.

Arc-lamp carbons.—Beacon Carbons, Ltd.; General Electric Co., Ltd.

Tramways Committee. Recommended:—

Two rotary converters and switchgear for Barrachnie sub-station.—Metropolitan-Vickers Electrical Co., Ltd.

Trolley wire.—British Insulated & Helsby Cables, Ltd.

L.p. cables.—Western Electric Co., Ltd.; Siemens Bros. & Co., Ltd.

Lighting Committee. Accepted:—Annual stores.

Electrical fittings and accessories.—Wood & Cairns; British Electric Manufacturing Co.; Aiston, Scott & Co.; Brown & Co.; T. Land and Son; Simplex Conduits, Ltd.; General Electric Co.; Malcolm and Allen; McGeoch & Co.

Leyton.—The Urban District Council is recommended to authorise the sealing of the following contracts:—

E.h.p. cable.—Hackbridge Cable Co., Ltd.
L.p. cable.—Enfield Ediswan Cable Works, Ltd.
Motor converter and l.p. switchgear.—Bertram Thomas.
Additional panel to switchboard.—Reyrolle & Co., Ltd.

London.—ST. MARYLEBONE.—When the Electricity Committee's recommendation for the acceptance of the tender of the British Insulated and Helsby Cables, Ltd., for the supply of underground cables during the period ending March 31st, 1924 (although their price was higher than the tenders of the Enfield-Ediswan Co. and the Hackbridge Cable Co., Ltd.), was again put forward, after being referred back for reconsideration, the Council discussed the matter further, and disapproved of the Committee's proposal. The matter has been referred to in this column of the REVIEW on several occasions in and since March, the full list of tenders being quoted in our issue of March 23rd, p. 460. At the Council meeting on May 10th (as reported in the *Marylebone Mercury*), Councillor F. W. Dean, chairman of the Finance Committee, opposed the Committee's recommendation. He pointed out that, whereas the British Insulated Co. asked £15,774 per thousand yards of each of the sizes mostly used of lead-sheathed low-pressure cable, the Enfield-Ediswan Cable Works, Ltd., a firm of high standing and repute, but not in the combine, was prepared to supply the same article at £14,711. Alderman Beaumont had told the Council that altogether some 15 miles of cable would probably be laid during the coming year, and as a considerable proportion of it would doubtless be of the low-pressure variety, the extra expenditure involved by dealing with the recommended concern would be very considerable. He, therefore, moved that in each case the Council should accept the lowest tenders sent in by firms of standing and repute, *viz.*: Low-pressure cable (two varieties), the Enfield-Ediswan Cable Works, Ltd., £13,291 and £14,711 per thousand yards. High-pressure cable (two varieties), the British Insulated and Helsby Cables, Ltd., £2,336 and £2,502.

Alderman J. T. Watson seconded the amendment, and, when put to the vote, this was carried by 31 votes to 15.

HACKNEY.—Works and Open Spaces Committee.

Electric vehicles for house refuse.—The Committee recommends, for experimental purposes, that one of the electric vehicles be fitted with a 44-cell, d.p., T.R. 27-type lead battery, with a 310 amp.-hour capacity, and one with a Ni-Fe T.K. 38-type nickel-iron battery, 380 amp.-hour capacity, in lieu of Chloride batteries, at an additional expenditure of £288.

STEPNEY.—Electricity Supply Committee. Accepted:—

One mile, 3-in. 3-way; ½ mile, 4-in. 3-way; and 1 mile, 3-in. single conduits (£912).—Sutton & Co. (Overseal), Ltd.
Twelve single-feeder boxes (£99).—W. Lucy & Co., Ltd.
Wrought-iron circulating pipes at Limehouse generating station (£2,810).—Clayton, Son & Co., Ltd.

The following offers of coal have been accepted:—

5,300 tons of Walsall wood-washed beans (27s. 7d. per ton).—E. Foster and Co.
1,700 tons Tamworth small nuts (30s. 7d. per ton).—Bradbury, Son and Co. (1920), Ltd.
100-120 tons Kingsbury washed fine slack (22s. 10d. per ton).—E. Foster and Co.
130-150 tons Mansfield nutty slack (28s. 6d. per ton).—Denham Fawcus.
100-120 tons Whitwick d./s. nuts (33s. 6d. per ton).—Southern Fuel Co.
200 tons Scotch single nuts (32s. per ton).—J. Hudson & Co., Ltd.
One barge Tamworth small nuts (33s. 1d. per ton); and 1 barge Staffordshire 1¼-in. slack (26s. 9d. per ton).—Bradbury, Son & Co. (1920), Ltd.
150 tons Rossington 1¼-in. slack (27s. 6d. per ton); 100 tons Hucknall 1¼-in. slack (27s. 6d. per ton).—Charrington, Gardner, Locket and Co., Ltd.

South Africa.—A correspondent says that Messrs. Babcock & Wilcox, Ltd., have secured an important contract in connection with a one-million pounds electric power extension at the instance of the Victoria Falls Power Co.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

WE have to remind readers that Service Department inquiries should be accompanied by a stamped addressed envelope.

The makers or suppliers of the following device are asked for:—

SUNFLOWER (Smith's Patent) vacuum cleaner.

Nitrates from the Air.—A new method in the manufacture of nitrates from the air is stated to have been discovered by the research chemists of Messrs. Brunner, Mond & Co. at their synthetic ammonia and nitrates factory at Billingham, near Stockton. The factory is only just entering on the manufacturing stage, and it has been stated that ultimately £5,000,000 will be sunk in this particular enterprise, which was originally started by the Government during the war, and later taken over by Messrs. Brunner, Mond.—*Evening News.*

THE BIRMINGHAM CORPORATION ELECTRICITY UNDERTAKING.

The New Nechells Generating Station.

(*Concluded from page* 821.)

The turbine room, fig. 9, will ultimately house seven generating sets of a total capacity of 105,000 kW, of which two 15,000-kW turbo-alternators by the British Thomson-Houston Co., Ltd., are now in operation, while a third set by the General Electric Co., Ltd., is being erected. Each 1,500-r.p.m. Curtis combined impulse turbine has 17 stages, the first having

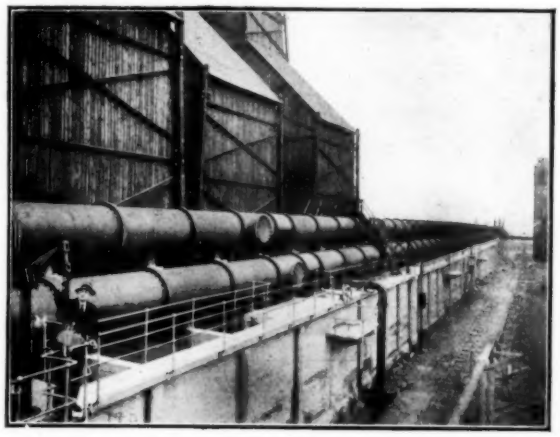


Fig. 8.—Cooling Tower Bus-pipes.

two rows of rotating buckets and the remainder one row each. Owing to high steam temperature, several nozzle diaphragms are of cast steel, cast-iron being used for those at later stages. The bearings are lubricated under pressure by means of a valveless rotary oil pump, a separate turbine-driven oil pump being provided as a stand-by and for use when starting and stopping the set; should the main pump fail, the second one will start automatically. The governor actuates the valves through an oil relay system, and during synchronisation the governor is controlled from the switch room by means of a reversible 220-volt, d.c. motor; the steam pressure is 300 lb. gauge per sq. in.; superheat, 278 deg. F.; total temperature, 700 deg. F.; and vacuum, 28 in. The weight of the turbine, with valves, bearings, pipework, &c., is 96 tons.

The 22,500 - kVA, three-phase, 25-cycle, 5,500 - volt, totally-enclosed alternators are standard machines, being coupled direct to the turbines by double claw flexible couplings. The size and weight of the stators being beyond the limits imposed by the railway companies, it was necessary to cast the frames in halves and to assemble them as well as build up the laminated cores *in situ*. Shrouded fans are mounted on the generator shafts, and the ventilating air is drawn through twin wet filters of Messrs. W. Grice & Sons' Invincible type, fig. 13; each twin unit will deliver 60,000 cu. ft. of air per minute, a d.c. 450-volt, $1\frac{3}{4}$-h.p., B.T.-H. motor driving each filter at 960 r.p.m. The heated air from the alternators is led to the boiler furnaces.

Six-pole, shunt-wound, self-exciting, 125-kW, 220-volt exciters are mounted on extensions of the turbo-generator bed plates; the machines have commutating poles and are connected direct to the alternator rotor windings without series rheostats, control being effected by means of Ferranti rheostats in the shunt field circuits. The main shunt windings are supplemented by auxiliary shunt windings so arranged that they can be excited from any available d.c. source, their function being to ensure stability when the alternators are being excited at low loads.

In addition to the machines above described, each main generator is provided with a 250-kW, 450-volt, shunt-wound generator, contained in the same magnet frame and its armature being mounted on the same shaft as the exciter, but otherwise constituting an independent machine, its duty being to supply power to the auxiliary machinery of the generating unit of which it forms part; it is designed to give its rated output notwithstanding a 10 per cent. drop in speed.

All the exciters are capable of an output 20 per cent. in excess of the maximum needed to excite the main generators and, in addition to the individual exciters, a stand-by exciter set has been provided in the form of a 220-volt, 485-r.p.m. motor generator driven by a 400-volt, 25-cycle, 3-phase protected induction motor. The total weight of each generator, including bed plate, bearings, exciter, and auxiliary generator, &c., is 138 tons.

Besides the main generating plant, the turbine room contains at present three Bruce Peebles 350-kW motor

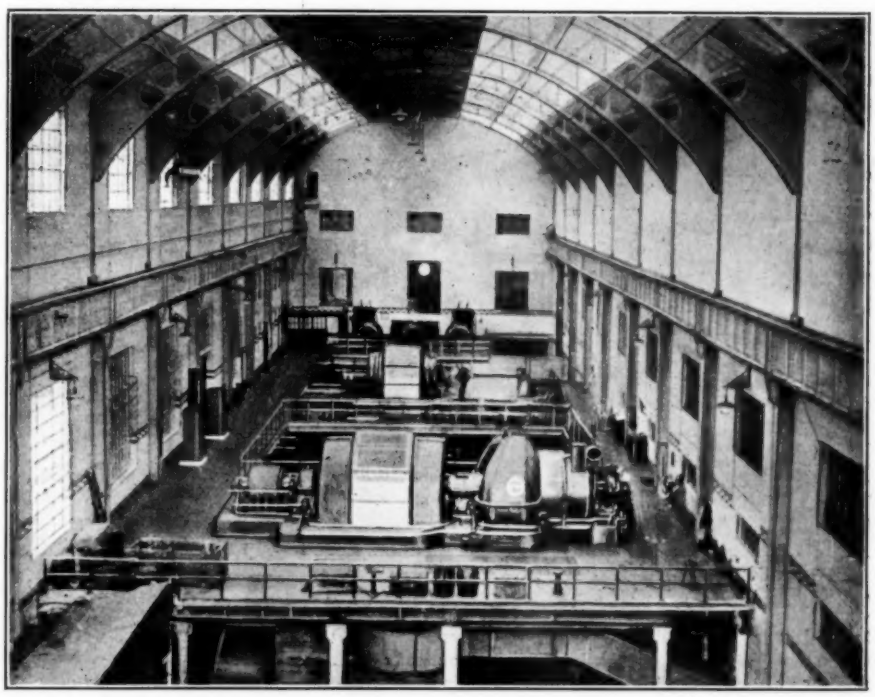


Fig. 9.—New Turbine Room at Nechells.

generators; these sets operate at 490 r.p.m., the motors being 5,350-volt, 3-phase, 25-cycle machines and the generators delivering 795/730 A d.c. at 440/480 volts for supplying the station auxiliary plant.

Messrs. Stothert & Pitt, Ltd., supplied the electric travelling crane for the turbine room; it has a span of 62 ft. 2¼ in., the height of the 100-ton lift being 48 ft., and that of the auxiliary 25-ton lift 50 ft., with hoisting speeds of 3 and 12 ft. per minute respectively.

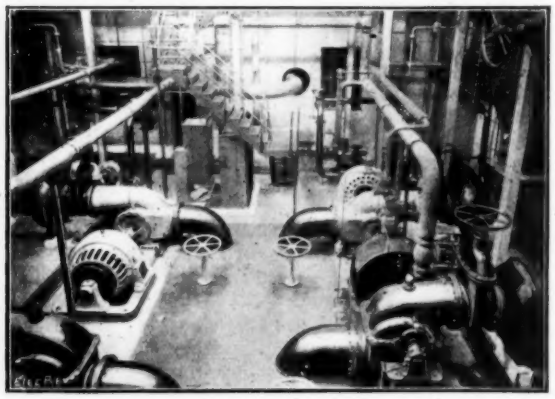


FIG. 10.—CONDENSING PLANT.

The condensing plant, figs. 10 & 11, at present installed was supplied by Messrs. G. & J. Weir, Ltd., and is arranged in two sets, each consisting of one Weir Uniflux surface condenser; one turbine-driven and one Drysdale (E.C.C., 220-h.p., 450-volt, 600-r.p.m.) motor-driven water circulating pump, each designed for half duty; one Weir turbine-driven and one Drysdale (E.C.C., 25-b.h.p., 450-volt, 1,100-r.p.m.) extraction pump, each designed for full duty; two steam-jet air ejectors; an ejector heater; a direct-contact boiler feed-water heater; a turbine-driven and two steam-driven direct-acting boiler feed-water pumps; three evaporators; and tanks. The switchgear for the condensing plant is of the

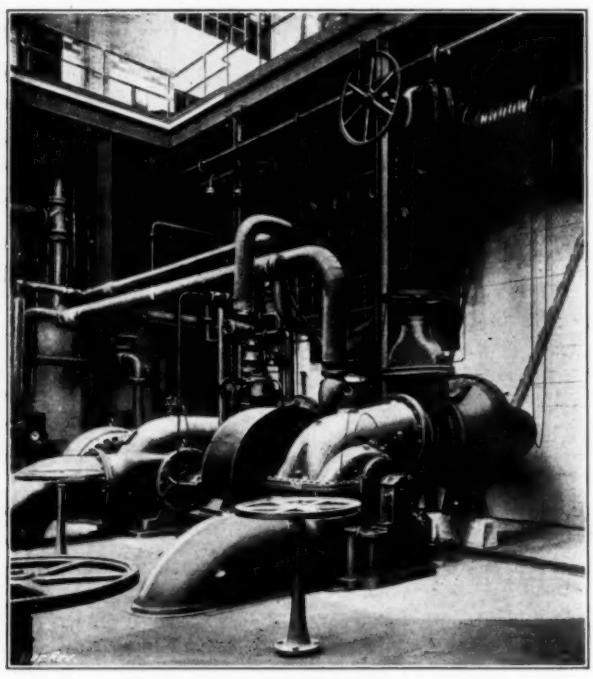


FIG. 11.—CONDENSING PLANT.

Brookhirst type. Each condenser will deal with 198,000 lb. of steam per hour and maintain a vacuum of 28 in. with an output of 18,000 kW, *i.e.*, an overload of 3,000 kW, and a circulating water temperature of 75 deg. F.

The method of operating the condensing plant is as follows:—The condensate pumps discharge, first, through the ejector heater, and secondly, through the direct-contact heater to the hot-well. Air and any other non-condensable gases are discharged by the 2-stage steam jet to the ejector heater, wherein the heat is transmitted to the water discharged by the extraction pump, the heater draining into the cold-water tank. The direct-contact heater is supplied with exhaust steam from the turbine circulating and extracting pumps, and should the supply be in excess of that needed to raise the hot-well temperature to 180 deg. F., the excess exhaust steam is automatically diverted either to a l.p. stage of the turbine or to the condenser. When the hot-well water level falls below normal, a float valve admits saturated

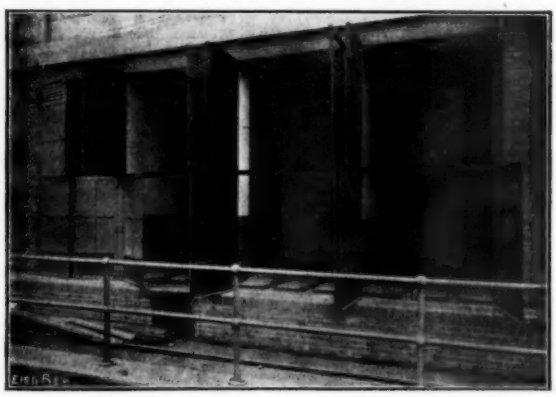


FIG. 12.—E.H.P. TRANSFORMERS.

steam to the evaporators, the vapour from which is condensed in the direct-contact heater before it passes to the hot well; the source of the evaporator steam supply is a l.p. stage of the main turbine. In the event of the water level continuing to fall during the period when the evaporators are called into service and have not reached their normal output, or when the feed pumps

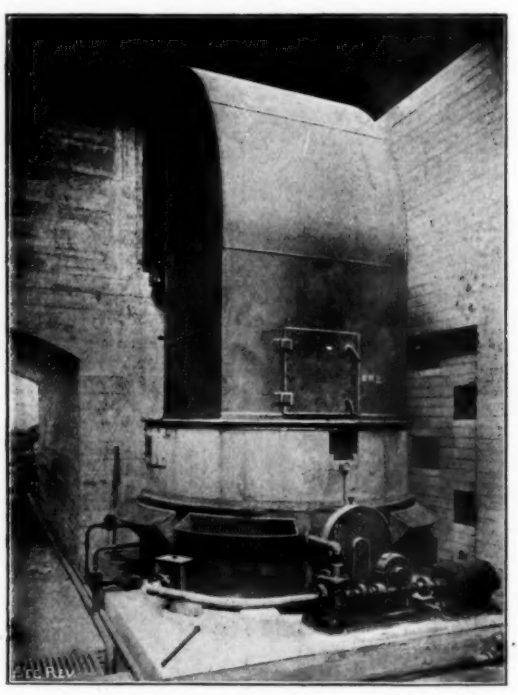


FIG. 13.—WET AIR FILTER.

are drawing more water than is being discharged by the extraction pumps, a second float valve admits water to the hot well from the condensed water tank. The latter also has a float which, when the water level falls, admits

Fig. 14.—Main Control Switchboard.

saturated steam to the evaporators and, at the same time, supplies water to this tank through a calibrated diaphragm in the extraction pump discharge range; any further fall in the level of the condensed water tank admits cold make-up water through a float valve.

The condenser water mains have a 36-in. internal diameter, the same as the condenser branches, which discharge into 48-in. overhead mains, fig. 8. The pipework was done by Messrs. E. E. Jeavons & Co., Ltd.

The first 17 natural-draught chimney-type towers were supplied by the Davenport Engineering Co., Ltd., and will reduce the temperature of 2,877,500 gallons of water per hour from 92 to 75 deg. F., with an atmospheric temperature of 55 deg. F. and 80 per cent. humidity.

An artesian well is available from which to draw the make-up water if necessary, but normally the purified sewage effluent from the filter beds adjacent to the cooling-pond site is used. Formerly some three million gallons of effluent were discharged daily into the River Tame, and it was first used for condensing at the temporary station, where it proved to be very suitable for the purpose. A chlorinating outfit was supplied by the Paterson Engineering Co., Ltd.

The switch house ground floor accommodates the oil cooler and pump as well as the transformers, fig. 12,

Fig. 15.—Temperature Control and Station Switchboard.

supplied by Messrs. Ferranti, Ltd., which step up the generated pressure of 5,000 V to 30,000 V at which power is transmitted by underground cables to the Summer Lane generating and Bournville sub-stations.

The present installation of switchgear consists of a main 7-panel board, fig. 14, with Reyrolle "M"-type switches controlling the two 18,750-kVA alternators, and five 10,000-kVA feeder panels, one being a spare. The station boards, fig. 15, comprise (*a*) 12 panels with Reyrolle "A2" gear controlling two 10,000-kVA, six (one spare) 2,500-kVA, and two 3,000-kVA feeders, the remaining two panels being occupied with duplicate tier and interconnector switches, as the board is divided into two sections and is fed from two feeders from the main board, the circuits including reactance coils; (*b*) two motor-generator and station-lighting transformer panels with Reyrolle "A2" gear for receiving the split feeders from board (*a*); all the above-named boards are 5,000-V, 25-cycle, three-phase.

Two panels with Reyrolle "R1" gear serve to isolate the 3-phase, 25-cycle, 30,000-V transmission lines, while the 3-panel, 3-phase, 25-cycle, 400-V and 8-panel, d.c., 450-V station auxiliary boards, seen to the left of fig. 14, were supplied by Mr. Bertram Thomas. On the left of

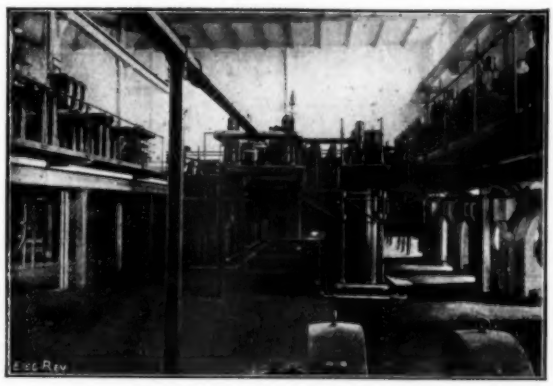


Fig. 16.—E.H.P. Switchroom.

fig. 15 is seen the Cambridge & Paul instrument board, by means of which the temperature of the various machines is kept under observation; the station is completely equipped throughout with measuring and recording instruments, telegraphs, &c., and the following types of automatic protection are included: Merz-Price current balance on the generators and trunk feeder transformers, with overload and inverse time limit on the group feeders. The group feeders include reactance coils supplied by the British Insulated & Helsby Cables, Ltd.; the cables were supplied by W. T. Henley's Telegraph Works Co., Ltd., and Callender's Cable and Construction Co., Ltd., and the latter carried out the whole of the switchboard wiring.

In conclusion, we have to thank Mr. R. A. Chattock for permitting us to visit and describe the station and his chief assistant engineer, Mr. F. Forrest, the resident engineer at Nechells, Mr. P. R. Boulton, and other members of the staff for their assistance.

THE ROTHERHAM ELECTRICITY UNDERTAKING.

Inauguration of 40,000-kVA Turbo-Generator.

It will be remembered that the insistent demand for electricity in the Rotherham district, due chiefly to the rapid growth of steel works and similar undertakings, necessitated the building of a new generating station to supplement, and eventually replace, the old adjacent station, the two being interconnected to permit the interchange of 5,000 kW, so that the continuity of supply is assured in the event of one of the stations being shut down.

The new station was planned under the direction of Mr. E. Cross, engineer and general manager of the Corporation Electricity Department, to have an ultimate plant capacity of 125,000 kW, and it is destined to play an important part in the provision of electricity in the North-East Midlands Electricity District, the Electricity Commissioners' approval of the formation of a Joint Electricity Authority for which was referred to in our issue of May 18th, 1923.

Fig. 1.—Control Room at Rotherham.

The plans include the provision of four sections of switchgear separated by bus-bar reactance, but at present only two sections have been installed, one of which includes the control apparatus of two Parsons 12,500-kW turbo-generators (a full description of which was published in our issues of October 29th and November 5th, 1920), and the other including control gear for the 30,000-kW set supplied by the British Thomson-Houston Co., Ltd., which was officially placed in commission by H.R.H. the Prince of Wales on Monday last.

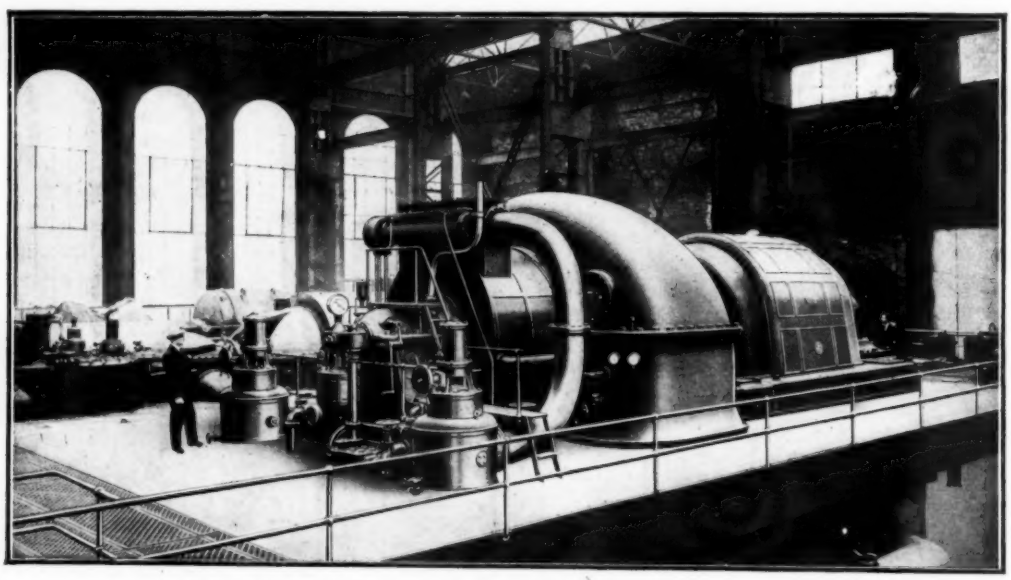


Fig. 2.—The 30,000-kW B.T.-H. Turbo-Generator at Rotherham.

This set is probably the most interesting feature of the whole of the plant in the station, inasmuch as it is the largest single power generating unit installed in the United Kingdom—its continuous output corresponds to 40,000 h.p. at a speed of 1,500 r.p.m.

The Curtis turbine has 14 stages, the first stage wheel having two rows of blades and the remainder one row each, the largest wheel being 12 ft. in diameter. Steam, superheated to a temperature of 200 deg. F., is admitted at a gauge pressure of 220 lb. per sq. in., the average vacuum being 28.5 in.; the full-load steam consumption under these conditions is 342,000 lb. per hour, and at the most economical load of 25,000 kW it is 277,500 lb. per hour.

The 3-phase, 50-cycle, alternator is capable of a maximum continuous output of 40,000 kVA at 6,600 volts and a power factor of 75 per cent. It is of the totally-enclosed, air-cooled type.

The alternator is self-ventilating, and shrouded fans are attached to each end of the rotor for creating the necessary draught. The intake air is drawn through a washing plant, which removes dust.

The core is clamped between cast-iron end flanges secured to the frame by means of screws, the use of bolts passing through the punchings being avoided. The stator winding is of the bar type in two layers in open slots. The ends of the winding are supported by bronze rings well insulated.

The one conductor per layer per slot is insulated with successive wrappings of varnished mica tape hot pressed to dimensions and continued throughout the entire length of the coil. The copper laminations comprising one conductor are also individually insulated without a break through the entire length of the winding from the h.p. to the neutral terminals; in this way extra losses due to eddy currents are reduced.

The rotor is of the cylindrical non-salient pole type with distributed windings, and there was no difficulty in transporting it so that it was completed at the works, thus enabling running balance, overspeed, and insulation tests to be carried out before despatch. Its critical speed is approximately 1,000 r.p.m., and the shaft journal at the exciter end is carried in a special "slip" bearing arranged to permit of a small radial play between friction collars, the radial movement thus allowed when running through the critical speed with the resulting work which is done on the friction collars destroying any tendency of the shaft to "whip."

The h.p. end of the turbine casing is of cast steel and the l.p. end of cast iron; the casing is divided horizontally, and round the periphery of each cast-iron diaphragm are cast-steel plates shaped to form the nozzles. These diaphragms are in halves, the top halves being fixed to the top casing, and the first stage nozzles are in four segments, two of them being bolted to the top half of the casing and two to the bottom half, as steam is admitted at the bottom as well as the top of the casing. The wheels are of steel and the blades of bronze, with the exception of those on the last two wheels, which are of carbon steel, sherardised to prevent corrosion. A thrust bearing of the multi-collar type is attached to the steam-end bearing, so arranged that by means of a worm the axial clearance of the rotor may be adjusted while the turbine is running.

The turbine and generator rotors are connected by means of a flexible coupling, the claws being lubricated from the adjacent bearings. The centrifugal governor, driven by a worm and wheel from the turbine shaft, maintains the speed constant within 3 per cent. from no load to 30,000 kW, and is provided with both hand and electrical adjustment, by means of which the speed can be varied 5 per cent. above or below the normal. The two main stop valves are also arranged to act as emergency valves and to shut off the steam, if the speed of the turbine exceeds 10 per cent. above normal, automatically by means of an unbalanced steel ring which, at normal speed, is held concentrically with the shaft by means of a spring, but which, at a higher speed, flies eccentrically due to the increased centrifugal force and comes into contact with a trigger that trips the valve mechanism. Means are also provided for hand and electrical tripping at any time, the electrical tripping being performed by means of a solenoid operated from the switchboard.

The oil for operating the governor servo-motor and for the general lubrication of the bearings is supplied under pressure by a pump driven from the turbine shaft through a worm and wheel. An auxiliary turbine-driven pump is arranged to come into operation automatically if the oil pressure drops below a prearranged figure, and is also used when starting and stopping the turbine.

Owing to the limitations of the British railway loading gauge, it was necessary to re-assemble on site several of the largest wheels of the steam rotor, and the electrical stator had to be dispatched in parts and erected on site. The total weight of the machine is 300 tons, the weight of the turbine being 145 tons. It occupies a floor area of 47 ft. by 20 ft. 6 in., the height above floor level being 12 ft.

The exciter is a 4-pole, shunt-wound, self-exciting machine with commutating poles, the control being effected by a rheostat in the shunt field circuit. The alternator has high internal reactance, so that external reactors are unnecessary. The actual voltage variation is reduced to a value not exceeding approximately 2 per cent. above or below normal at any load by the generator being designed to operate normally in conjunction with an automatic Tirrill regulator.

The interesting test of subjecting the turbo-alternator to a sudden single-phase (line-to-line) short circuit was described in our issue of May 4th last; fig. 2 shows the set itself, while fig. 1 is a view of the control room at the new Rotherham station. The field rheostats are electrically operated, and in order to facilitate synchronising a special voltmeter is provided for indicating the difference between the incoming machine and the bus-bar voltages.

All the generators are provided with balanced-current protective gear which functions in the event of a fault occurring in the machine windings or cables between the machines and the switchgear cells. Automatic field-suppression switches are provided so as to kill excitation after the generator oil switch has been tripped by the operation of the balanced-current relay. A neutral point earthing resistance is provided for each machine, together with an oil-immersed hand-operated isolating switch, and in order to provide against sustained faults on feeders and faults on the station bus-bars, each generator is equipped with a definite time-limit overload and earth-leakage stand-by relay.

"The great electric power station which your Royal Highness will open this afternoon is evidence of the confidence that this Corporation has in the future."

This phrase, from the address of welcome by the Corporation of Rotherham to the Prince of Wales on the occasion of his visit to that town on Monday of this week, prompted the following reply from His Royal Highness:

"Rotherham," he said, "has always enjoyed a reputation for progressiveness, and it was in keeping with that reputation that among the many large electric power stations in England, the first super-station should have been erected here. In a district such as this, the demand for electrical power is naturally enormous—without it the industrial expansion of the neighbourhood would be seriously hindered; and it was inevitable that this demand should increase markedly after the war. It is a tribute to your long-sightedness in Rotherham that you forestalled this demand, and a tribute to your engineers that you have been able to meet it so successfully. This new station is a very important addition to the electrical resources of Yorkshire, and I am glad to hear that it is proving of material assistance to the industrial progress of a wide area."

The Prince, when he declared the station open on Monday, decreed that it should be known in future as the "Prince Edward" station, and the large turbine which he set in motion bears a plate recording this fact.

After declaring the station open, the Prince, under the guidance of Mr. Edward Cross, made a tour of inspection of the works. He also switched on the lamps which illuminated a large picture of the Prince of Wales's coat-of-arms, and afterwards started the whole of the machinery.

The Prince of Wales in a Sheffield Steel Works.—On Tuesday last, during his tour in Sheffield, the Prince of Wales visited the large steel works of Messrs. Hadfields, Ltd., and started a new rolling mill, which is driven by an electric motor of 12,000 h.p. This huge motor is capable of reversing from a full speed of 120 r.p.m. in one direction to a similar speed in the opposite direction in the incredibly short period of 2½ seconds. The enormous currents required for short intervals during the rolling operations are dealt with by a 30-ton flywheel, coupled to the generators which supply the mill motor. Thus the power required from the power mains is limited to that required for average loads. The electrical equipment of the mill was supplied by the British Thomson-Houston Co., Ltd.

REVIEWS.

Industrial Electric Heating. By J. W. BEAUCHAMP, M.I.E.E. Pp. 118; figs. 41. London: Sir Isaac Pitman & Sons, Ltd. (Technical Primer Series). Price 2s. 6d. net.

As director and secretary of the Electrical Development Association, Mr. Beauchamp is well equipped to write upon practically any electrical matter, and his choice of heating as a subject is calculated to stimulate interest in a branch of the use of electricity which can be developed far beyond its present state.

One of the sub-headings in the introductory chapter says: "Direct cost often unimportant"; this is the principal plank in the platform of electrical propaganda, and one which must be constantly insisted upon. It is unfortunate that the advantages of electricity are not capable of being reduced to direct cash saving; they are to a great extent hidden, but are no less real on that account. In other words, only actual experience can convince a manufacturer (or a householder) that electricity must not be judged by what it *appears* to cost.

It is the function of such a work as this to lead those who are hesitating to make a change in their heating systems and processes to look below the surface, and so far as we can judge, from the inside, as it were, the case is admirably put.

We think that the initial chapter upon the "Economics of Electric Heating" possesses all the force of the publications which from time to time emanate from the E.D.A. headquarters, and to say this is to say a great deal. The second chapter is an effective argument against those who speak of the "inefficiency" or "wastefulness" of electric heating. It acknowledges the low heat efficiency of power stations which, however, is not all of the story.

After this succinct introduction, the author turns to actual practice by describing in a general manner the construction of ovens and muffles, noting a number of processes in which they may be employed, and, indeed, several in which nothing else can be employed, *e.g.*, the automatic hardening of carbon-steel. The following chapter deals with the melting of metals in electric furnaces, and a table is given showing the power, time, and energy consumption for melting non-ferrous metals from which costs may be estimated with a fair degree of accuracy.

Welding is the subject of the next chapter, and in it are described various welding machines and methods. A particularly good example of a large weld—prepared and finished—is illustrated.

The next chapter is of a general nature dealing with electrically-heated tools and appliances, ranging from sealing wax heaters to electrically-heated clothing. This section serves to show the universality and adaptability of electric heating.

This is followed by a short chapter on "Electric Heating in the Preparation of Food," principally as applied to large establishments—restaurants, works canteens, bakeries, &c.

The last two chapters are more in the nature of appendices, as they deal respectively with wiring installation work and the purchase of electrical energy. The former deals with conductor sizes, earthing, and fuses and circuit breakers in a brief manner, and is apparently meant as a pointer to more elaborate works on the subject, or an indication of "points to watch" when considering an installation.

The final chapter treats of the various systems of charging in vogue, and forms a guide to the calculation of the amount of energy used. A large portion of the chapter is concerned with heat storage by means of water. An appendix contains a great deal of miscellaneous information, including tables of the melting points of metals; density, specific heat, boiling points, &c., of various substances; and particulars of nickel-chromium wire.

Electrons, Electric Waves, and Wireless Telephony. By J. A. FLEMING, M.A., D.Sc., F.R.S. Pp. viii+326; figs. 112. London: The Wireless Press, Ltd. Price 7s. 6d. net.

This book, which has recently appeared as a series of articles in the *Wireless World and Radio Review*, is a reproduction, with amplification, of the course of juvenile lectures given at the Royal Institution, by Dr. Fleming, at Christmas time, 1921.

It is a book which can be confidently recommended to the large body of amateur experimenters in wireless telephony, as it gives that authoritative and clear explanation of fundamental theory which the amateur is apt to lack, as he finds it so difficult to obtain this information from text books, or from that great mass of literature, which, though specially written for him, usually gives him results without "wasting" time on the groundwork required for their proper appreciation.

The author avoids mathematical explanations with success, and anyone who can grapple with a square root can assimilate all that is put before him. Not that the book is of the class which can be read without concentration; it contains far too much information to make such pleasant, if unprofitable, reading. On the other hand, it has the personal touch of a book of lectures, and thus escapes the dryness of a text-book.

The author uses "broadcasted" for "broadcast" in his foreword, no doubt a mis-print, like "no particular," &c., for "one particular," &c., on page 248.

The printing and general get-up are good, and a useful index is included.

The Radio Experimenter's Handbook. By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E. Part 2. Pp. vi+72; figs. 63. London: The Wireless Press, Ltd. Price 3s. 6d. net.

This is the second edition of a book which was originally welcomed by many serious amateur experimenters, or rather a second edition of its appendix. Part 1 of the new edition deals with the general principles of design, Part 2, which is the portion under review, with data and quantitative design.

The author sets out by describing how to measure currents and voltages, passes on to explain the formulæ and data governing wave lengths, condensers, inductances, coupling, resistances, and in fact the whole make-up of a receiving circuit, and finishes off with an explanation of how various measurements can be made with valve circuits. The numerous examples given, and the fact that only simple mathematical formulæ are used, ensure that the book will be of real assistance to that increasing and valuable body of experimenters, who meet a square root and a curve with equanimity, but are not necessarily on speaking terms with the calculus.

Four Lectures on Relativity and Space. By C. P. STEINMETZ, A.M., Ph.D. Pp. x+126; figs. 33. London: McGraw-Hill Publishing Co., Ltd. Price 10s. net.

The four lectures delivered by Charles Proteus Steinmetz, A.M., Ph.D., past president of the American Institute of Electrical Engineers, on "Relativity and Space," are now published in this country by the McGraw-Hill Publishing Co., Ltd. The author begins his preface with the statement: "The theory of relativity developed by Einstein and his collaborators is the greatest scientific achievement of our age." Substitute "mathematic" for "scientific" and probably no one will dispute the statement; it is a staggering achievement, and seems to exercise a strange and persistent fascination on all intellectually minded men, including those who are not mathematical or even scientific. Inquiries about it are made by poets, artists, and medical men, with the result that there has been a steady issue of books from the Press, designed to acquaint those, whom Prof. Steinmetz euphoniously styles *laymen*, with the main principles and general conclusions of the theory. In the particular example under review the author's aim is to give the reader a general conception of the theory by analogy, example and comparison; and he pursues it with great ingenuity and success. Among other devices are included a number of stereoscopic views on separate cards contained in a pocket inside the back cover of the book, and the objects presented, being smaller than the distance apart of our two eyes, it is easy for those, who know how to use their eyes, to obtain the stereoscopic image without the help of a stereoscope. The book is rich, both in examples and illustrations, thus: "The energy equivalent mc^2 of one pound of dirt would run all the mills, factories, railroads, &c., and light all the cities and villages of the United States for a month. It would supply the fuel for the biggest transatlantic liner for 300 trips to Europe and back. And if this energy of one pound of dirt could be let loose instantaneously, it would be equal in destructive power to over a million tons of dynamite." The illustration of what 4×10^{43} cubic miles amounts to, which is the magnitude assigned by the theory of relativity for the total volume of the universe, is even more copious.

Of course, the conceptions to be obtained of Einstein's work, by the means to which the author confines himself, are necessarily but approximate and cannot be rigidly correct; moreover, the fact that it involves certain arbitrary assumptions can only be stated, not explained; but this is inevitable and is no obstacle to the utility of the work, for all those who, having a general acquaintance with elementary mathematics and mechanics, desire to inform themselves upon the main deductions and conclusions of relativity. To most of our readers the book will probably prove more interesting than the ordinary novel turned out for purposes of the trade. The writer has a perspicuous style, and a great deal of his meaning may be gathered without dwelling on the mathematical equations he finds it necessary to introduce. There is something inspiring in the idea that if we only live long enough and discover how to make telescopes of sufficient power, we may ultimately be able to see the backs of our own heads. To be sure, we should have to live 400,000,000 years to do it, so the prospect is not an immediate one, but is it the less inspiring for that? That gravity can be accounted for by curvature of space is also inspiring; but a somewhat disconcerting feature of the theory, not in this work sufficiently emphasised, is that the curvature imputed is not the same for every one, since it varies according to the situation of the observer.

FORTHCOMING EVENTS.

Institution of the Rubber Industry.—Monday, June 4th. At the Engineers' Club, Coventry Street, W. At 8 p.m. Paper on "The Use of Rubber Products as Dielectrics."

Royal Society of Arts.—Tuesday, June 5th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "The Economic Conference and the Colonies," by Sir E. Davson.

Roentgen Society.—Tuesday, June 5th. At the Institution of Electrical Engineers, Victoria Embankment, W.C.1. ANNUAL GENERAL MEETING.—Papers on "The Effects of X-rays of Different Wave Lengths on Animal Tissue," by Prof. S. Russ; and "On the Establishment of a Definite Relationship between Exposure and Density in an X-ray Plate," by Mr. T. Thorne Baker.

Institution of Electrical Engineers.—SUMMER MEETING.—Visits to Lancashire and North Wales. Tuesday, June 5th, to Friday, June 8th.

(Western Centre).—June 1st to 4th. At Plymouth. Summer meeting.

(Wireless Section).—Wednesday, June 6th. At the Institution of Electrical Engineers. At 6 p.m. Paper on "Wireless Direction-Finding in Steel Ships," by Mr. C. E. Horton.

Chemical Society.—Thursday, June 7th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary Scientific Meeting.

Physical Society of London.—Friday, June 8th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Lecture by Prof. J. G. G. Gray on "A General Solution of the Problem of Finding the True Vertical for all Types of Marine and Aerial Craft."

Diesel Engine Users' Association.—Friday, June 8th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Paper on "Losses in Heat Engines and Means of Avoiding Them," by Engr.-Comdr. W. P. Sillince, R.N.

Electrical Power Engineers' Association (Kent Section).—Saturday, June 9th. At the Carlton Café, Tunbridge Wells. General meeting.

NOTES.

South-East Lancashire Electricity Advisory Board.—As we go to press we learn that the South-East Lancashire Electricity Advisory Board, which has been in process of formation for two years, has now become a statutory authority, Parliament having confirmed the Order constituting the Board made by the Minister of Transport upon the recommendation of the Electricity Commission. Having secured the approval of both Houses of Parliament, the Board thus becomes a real and important body which will play a vital part in all future electrical development in the area.

It is obligatory upon the Board to appoint an Engineering Advisory Committee to guide it in its deliberations, which Committee will obviously be one of great importance, carrying heavy responsibilities.

The area of the Board's jurisdiction extends approximately from Wigan on the west to Glossop on the east, and from Whitworth/Ramsbottom/Littleboro' on the north to Knutsford/Macclesfield/Buxton on the south—by far the most important electrical area outside London, as will be realised when it is pointed out that one-tenth of the whole electrical output of the United Kingdom is generated therein.

It is significant of the important lead given by South-East Lancashire, that since it abandoned the principle of an owning and operating authority in favour of an Advisory Board, several other important areas have followed suit; moreover, although the preliminary notice by the Commissioners was issued in South-East Lancashire many months later than in certain other areas, the South-East Lancashire Electricity Advisory Board is the first authority of any kind to be set up as a result of the recent legislation for re-organising the electricity supply industry.

An Interim Board has been operating since October 17th last, in all respects as though Parliament had approved the Order, and has taken offices at No. 17, Albert Square, Manchester.

Alderman W. T. Dagnall, the Chairman of the Manchester Corporation Electricity Committee, was appointed Chairman of the Interim Board, which consists of some 50 representatives of all authorised undertakers and other local authorities and railway companies in the area.

The Engineering Advisory Committee of the Interim Board consists of the following gentlemen:—Mr. S. L. Pearce, Manchester; Mr. C. D. Taite, Lancashire Electric Power Co.; Mr. W. J. H. Wood, Bolton; Mr. S. J. Watson, Salford; Mr. F. L. Ogden, Oldham; Mr. R. Lomax, Stockport; Mr. R. Owen, Wigan; Mr. G. H. Fawcus, Altrincham Electric Supply Co.; and Mr. H. C. Busbridge, Swinton and Pendlebury.

The Stalybridge, &c., Joint Board has the right to send its engineer to any meeting of the Engineering Advisory Committee at which matters are to be considered affecting the area of the Stalybridge Board, or areas contiguous thereto, and the Engineers' Committee is entitled to co-opt the engineers of the Railway Companies. Mr. S. L. Pearce, C.B.E., M.Sc., chief engineer and manager of the Manchester Corporation Electricity Department, was appointed, and has acted as, Chairman of the Engineering Advisory Committee of the Interim Board. All appointments of chairman, committees, &c., will, of course, require to be formally made by the statutory Board at its first meeting, which must take place within six weeks from the date of the confirmation of the Order.

Mr. A. H. Banks, late chief assistant to the Town Clerk of Manchester, was appointed Clerk to the Interim Board on the understanding that he would be the Clerk to the statutory Board.

At the request of the Interim Board, Sir John Snell, Chief Electricity Commissioner, has indicated his willingness to preside at the first statutory meeting of the Board.

Appointments Vacant.—Switchboard attendant, for the Rawtenstall Corporation electricity department; commercial assistant, for the City of Birmingham electric supply department; electrical engineer, for the Worksop Urban District Council; assistant electrical engineer (Rs. 450 per month), for the Bombay-Baroda and Central India Railway.

The E.C.A. President Visits Ireland.—Mr. H. Marryat, the president of the Electrical Contractors' Association, has just returned from visiting the contractors in Ireland, where he was enthusiastically welcomed, both in Belfast and in Dublin. In Belfast particularly, he finds the contractors to be well together and on the best of terms with each other, and with Mr. Johnstone Wright, the city electrical engineer, and the local supply houses. The work carried out is of a high-class, and generally Mr. Marryat is of opinion that Belfast can teach many of the English branches of his Association a good deal. A lunch was arranged in this city, at which Mr. Johnstone Wright and he were honoured guests. The majority of the contractors were present, and it was evident from the speeches which were made that the utmost goodwill existed between all parties.

At Dublin the contractors have formed their own local association, only a few members of which belong to the E.C.A. This position has arisen owing, to some extent, to the local workmen's organisation having broken away from the E.T.U. It is expected, however, that some arrangement will be made to enable the Dublin contractors to join or affiliate with the E.C.A.

Helium Gas and its Uses.—In a pamphlet issued by the British Science Guild Publicity Service on this subject, Prof. J. C. McLennan, F.R.S., Director of the Physical Laboratory, University of Toronto, states that from 30,000 to 40,000 cu. ft. of helium gas are now being extracted daily from natural gas in the United States. The gas is being compressed in steel cylinders and stored for use in airships and for other purposes, and its export is prohibited by law. The new airships of the rigid type, now approaching completion for the U.S. Government, are to be inflated with helium instead of hydrogen. In the history of science there is no more remarkable example of the development of purely scientific research into industrial application than is afforded by helium. The gas was discovered on the sun twenty-seven years before it was found on the earth. It is one of the chief constituents of the great flames or prominences which are continually being spurted out by the sun to heights of tens of thousands of miles, and are seen during total eclipses of the sun. It can be obtained from many types of rocks and minerals and is present in practically all natural gases and spring waters. It also occurs in the atmosphere, in the proportion of about four parts to one million by volume. It has been proved to be formed by the disintegration of radium and other radio-active elements, and the alpha particles shot out by these elements with velocities of about 12,000 miles per second are actually atoms of helium. Sir Ernest Rutherford has succeeded in converting a certain amount of nitrogen gas into hydrogen by bombarding the gas with the nuclei of helium atoms in the form of alpha rays.

Next to hydrogen, helium is the lightest gas known. It is both non-inflammable and non-explosive, and possesses 92 per cent. of the lifting power of hydrogen, so that it is a most suitable filling for airship envelopes. The buoyancy can be increased at will by heating the gas by electric or other means. Moreover, the loss of gas from diffusion through the envelope is less with helium than with hydrogen by about 30 per cent.

Helium can be used to fill thermionic amplifying valves for use in wireless telephony, and also for filling incandescent filament lamps and arc lamps. The lowest temperature yet attained on the earth was reached by Prof. Kamerlingh Onnes, of Leyden, in 1918, by liquefying helium. The temperature was 490 deg. Fahr. below the freezing point of water and was within two or three degrees Fahr. of absolute zero. It was found by Prof. Onnes that a number of metals possessed a remarkable "super conductivity" at this temperature. Mercury, in particular, at the temperature of liquid helium conducts an electric current ten million times more easily than at ordinary room temperatures, and currents started by induction in a coil of lead wire at the temperature of liquid helium maintained their intensity for more than an hour with but little diminution in strength.

Before the United States Government had erected plant for the extraction of helium, Sir Richard Threlfall suggested that an inquiry into the helium content of supplies of natural gases within the Empire from the point of view of their development for aeronautical purposes should be carried out. This was in 1915, and the United States took up the subject when America entered the war two years later. A survey of all the natural gases within the Empire made by the writer and his associates showed that those from Ontario and Alberta, Canada, were richest in helium, though the proportion was relatively low, being about one-third per cent. of the natural gases. The supply from sources in Great Britain is almost negligible. From ten to twelve million cubic feet of helium could be obtained annually from natural gases in Canada. A magnificent cryogenic equipment has been installed in the Physical

Laboratory of the University of Toronto; with it large supplies of liquid air, liquid hydrogen, and liquid helium can be obtained.

The Ruths Steam Accumulator.—A new apparatus for equalising boiler pressure was described in a recent issue of *Glückauf*. This apparatus acts as a sort of shunt to the boiler and consists of a heat-insulated cylindrical tank in which is a pipe bearing a number of nozzles which are surrounded by tubes. This pipe communicates with the boiler pipe line by means of two valves. One, the admission valve, is a non-return, which is opened when the pipe-line pressure rises above a fixed limit, allowing the steam to enter and discharge through the nozzles. This causes the water in the tubes surrounding the nozzles to circulate, producing a gradual rise in the pressure of the accumulator. The second valve operates when the pipe-line pressure falls, allowing steam from the accumulator to make up the deficiency. Accessory devices prevent any accidental rapid discharge and the formation of a vacuum.

INSTITUTION NOTES.

Institution of Electrical Engineers.—The May issue of the *Journal* records the establishment of an International Consulting Committee for International Telephone Communication, and contains the report of the chairman (Mr. K. Edgcumbe) of the National Illumination Committee of Great Britain for the year 1922.

THE NEW COUNCIL.—The following have been nominated by the Council for the vacancies which will occur in the Council on September 30th, 1923:—

President (one vacancy): A. Russell, M.A., D.Sc., principal Faraday House Electrical Engineering College.

Vice-President (one vacancy): Sir James Devonshire, K.B.E., director, Underground Electric Railways Co. of London, Ltd.

Honorary Treasurer (one vacancy): P. D. Tuckett, chairman, Edmundson's Electricity Corporation, Ltd.

Ordinary Members of Council.—Members (five vacancies): * Capt. J. M. Donaldson, chief engineer, North Metropolitan Electric Power Supply Co. G. W. Partridge, managing director and chief engineer, London Electric Supply Corporation, Ltd. * Col. T. F. Purves, O.B.E., engineer-in-chief, General Post Office, London. * P. Rosling, general manager, W. T. Henley's Telegraph Works Co., Ltd. Prof. W. M. Thorton, O.B.E., D.Sc., Professor of Electrical Engineering, Armstrong College, Newcastle-on-Tyne.

Associate Member (one vacancy): * S. W. Melsom, principal assistant, Electricity Department, National Physical Laboratory.

* Have not previously served on the Council in any capacity.

Institution of Engineers (India).—The I.E.E. Premium, value £20, has been awarded by the Institution of Engineers (India) for the year ended August 31st, 1922, to Mr. A. Lennox Stanton for his paper on "Railway Electrification, with special reference to Indian Conditions."

Incorporated Municipal Electrical Association.—We have received a copy of the official programme of the annual convention in its final form; the latest date by which applications for tickets can be dealt with is June 5th. The convention will be held at Scarborough, June 18th to 23rd, and will include an official reception by the Mayor and Mayoress, the presidential address by Lieut.-Col. W. A. Vignoles, D.S.O., several papers and discussions, and evening entertainments.

Physical Society of London.—At the meeting held on May 11th, Sir William Bragg, F.R.S., chairman of the Duddell Memorial Committee, handed to the President a copy of the Memorial Medal, together with the dies and a certificate for the unexpended balance of the memorial fund. He said that the committee had been formed in response to a widely-felt wish that the work of this distinguished scientist should be commemorated in a suitable manner. A sum of no less than £700 had been subscribed, thanks in the main to the energy of Mr. R. S. Whipple, secretary to the committee.

Dr. ALEXANDER RUSSELL, President, in accepting the medal on behalf of the Society, said that he did so with gratitude to all who had combined to make this memorial possible, and particularly to Sir William Bragg and Mr. R. S. Whipple, whose initiative had set the undertaking on foot, while their perseverance had carried it to such a successful issue. He had always marvelled at the encyclopædic character of Mr. Duddell's technical knowledge, which, coupled with his mechanical skill and inventive ingenuity, had enabled him to make so many contributions of permanent importance to the progress of science and of industry.

Sir RICHARD GLAZEBROOK said that it gave him great pleasure to express his intense admiration for Mr. Duddell. The latter had been a cordial helper of the National Physical Laboratory, especially during the war, and had always been ready to give generously from his great store of knowledge and of scientific resource.

The eighth Guthrie lecture was delivered by Prof. J. H. Jeans, D.Sc., LL.D., F.R.S., who took as his subject "The Present Position of the Radiation Problem."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Sir. W. JOYNSON HICKS has now been appointed Financial Secretary to the Treasury and Sir L. WORTHINGTON-EVANS becomes Postmaster-General in his stead.

Mr. J. B. NICHOLSON, chairman of the English Electric Co. of Australia, Ltd., will be in London about the middle of June. His address will be care of The English, Scottish and Australian Bank, Ltd., Gracechurch Street, London, E.C.

The Dundee Corporation Lighting Sub-Committee has accepted the resignation as public lighting inspector of Mr. ALEX. YUILL, gas manager, and appointed Mr. R. D. ROBERTSON to fill the vacancy at a salary of £315.

Mr. ALEXANDER SIMPSON, H.M. Trade Commissioner at Sydney, who is now on a visit to the United Kingdom, will be pleased to interview firms interested in trade with Australia, particularly New South Wales, at the Department of Overseas Trade, from June 4th to 9th inclusive. Applications regarding the matter should be sent at once to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1 (Reference number 4757 T.G.).

A correspondent writes: "Mr. T. B. HOYLE, who was formerly employed by Messrs. Palmer, Riley & Co., electrical suppliers, of Accrington, has arrived in Los Angeles. In a letter home he gives a glowing account of the country."

At a social gathering, held in the Walthamstow Tramways Recreation Hall, on May 17th, under the auspices of the Tramway Employés Recreation Club and of the Walthamstow Branch of the National Association of Local Government Officers, Mr. E. W. BAYLISS (an assistant to the tramways manager) was presented with a canteen of cutlery from the staff of the Tramways Department and a standard lamp and cheque from the members of the N.A.L.G.O., to commemorate his recent marriage. The gifts were presented by Mr. Murray, representing the Tramways Department, and by Mr. S. J. Longman on behalf of the N.A.L.G.O.

Mr. SIDNEY SIMPSON, who was on the Yorkshire Electric Power Co.'s staff from 1908 to 1919, latterly as assistant to the engineer and manager, and has been (since 1919) associated with Mr. J. E. Schofield, Bradford, and Messrs. Mark Shaw & Sons, Ltd., Huddersfield, has now commenced practice as consulting engineer at 9, Market Street, Bradford. Telephone No. 6705, Bradford. He desires to receive manufacturers' catalogues.

Obituary.—MR. STOCKLEY.—The death has occurred very suddenly of Mr. Stockley, of Hawkstone, who had for some years had charge of the electricity plant on the Hawkstone estate.

NEW COMPANIES REGISTERED.

Automatic Coil Winder and Electrical Equipment Co., Ltd. (190,137).—Private company. Registered May 23rd. Capital, £10,000 in £1 shares. To acquire from S. H. Rawlings the benefit of certain existing inventions relating to an automatic coil winding machine and an instrument for registering electrical current and resistances, to be called an "Avometer." The first directors are:—F. B. Larkworthy, "Cooper's Bridge," Bramshott, Hants. (chairman); S. H. Rawlings, 4, Becmead Avenue, Streatham, S.W.16; F. C. G. Larkworthy, "Cooper's Bridge," Bramshott, Hants. Registered office: 9, Victoria Street, S.W.1.

E. Turner & Co. (Manchester), Ltd. (190,071).—Private company. Registered May 18th. Capital, £1,000 in £1 shares. To take over the business of an electrical engineer, plumber and contractor carried on by E. Turner at 20, Marsden Court, Fennel Street, Manchester. The first directors are:—E. Turner, 29, Morley Avenue, Fallowfield, Manchester; J. W. G. Johnson, 21, Birkdale Grove, Church Street, Eccles (secretary). Qualification, £50.

South Yorkshire Electric Welding Co., Ltd. (190,125).—Private company. Registered May 22nd. Capital, £3,000 in £1 shares. To carry on business as indicated by the title. The subscribers (each with one share) are:—J. Falconer, 10, King Edward Avenue, Mansfield, engineer; G. A. Hett, Hilcote, near Alfreton, engineer. J. Falconer signs as director. Remuneration as fixed by the company. Registered office: 28, Market Place, Mansfield.

Johnson & Turner, Ltd. (190,154).—Private company. Registered May 23rd. Capital, £2,000 in £1 shares. To acquire the business of electrical and mechanical engineers and contractors and patent projector lantern manufacturers now carried on by H. E. Johnson, M. C. Turner, and J. E. Lord at Manchester Road, Hyde, Cheshire, as "Johnson & Turner." The first directors are: E. Warrington (chairman), 51, Bennett Street, Hyde; H. E. Johnson, 30, Brook Avenue, Levenshulme, Manchester; M. C. Turner, 39, Victoria Road, Dukinfield; J. E. Lord, 12, Second Avenue, Catterick Hall, Didsbury, Manchester (all permanent, subject to each holding 100 shares). Qualification, £100. Secretary: E. Couldwell. Registered office: Manchester Road, Hyde, Cheshire.

Boston and District Electric Supply Co., Ltd. (190,063).—Registered May 18th. Capital, £20,000 in £1 shares. To acquire a transfer from R. A. Smith of the undertaking authorised by the Boston and District Electric Lighting Order, 1913, under the provisions thereof and to produce and supply electrical energy within the limits prescribed thereby. The first directors are:—W. B. Cownie, The Connaught Club, 75, Seymour Street, Marble Arch, W.2; G. H. Nisbett, J.P., Huyton, Liverpool. Minimum cash subscription, £100. Qualification, a share or stock of the company. Remuneration (except managing director), £100 each per annum (chairman £150). Secretary: E. A. Bond. Registered office: 62-3, Queen Street, Cannon Street, E.C.4.

British Gramophone and Wireless Co., Ltd. (189,998).—Private company. Registered May 16th. Capital, £10,000 in 7,500 preference shares of £1 each and 20,000 ordinary shares of 2s. 6d. each. To carry on the business of makers of and dealers in gramophones, gramophone records, and parts, musical instruments of all kinds; wireless installations and parts thereof, &c. Power is taken to carry on the business of makers of and dealers in machinery, furniture, motor-cars, cameras, scientific instruments, and leather, wood and metal goods, shipping and forwarding agents, carriers, decorators, furnishers, and builders, &c. The subscribers (each with one preference share) are:—S. C. Roberts, 2, Lansdowne Road, Guildford Street, W.C.1, engineer; G. B. Colson, 68, Lewin Road, Streatham, S.W.16, engineer. The subscribers are to appoint the first directors. Remuneration (if any) as fixed by the company. Solicitors: Reynolds & Sons, 7, Arundel Street, Strand, W.C.2.

Wireless Manufacturers, Ltd. (190,057).—Registered May 17th. Capital, £1,000 in 1,000 cumulative 10 per cent. preference and 1,000 ordinary shares of 10s. each. The objects are as indicated by the title. The subscribers (each with one preference share) are:—E. Seymour, 31, Harringay Park, Crouch End, N.8, merchant; C. H. Hambridge, 84, Constantine Road, Hampstead, N.W.3, merchant; E. M. Tilbury, 44, Wendover Road, Staines, clerk; F. P. Hawkins, 69, Boundaries Road, Balham, S.W.12, engineer; E. Holwill, Temple Chambers, E.C.4, merchant; H. Atkinson, 54, Hillcrest Road, Acton Hill, W.6, machinery agent; H. W. Saunders, 5-6, Clement's Inn, W.C., solicitor's managing clerk. Minimum cash subscription, 7 shares. The subscribers are to appoint the first directors. Remuneration, £50 each per annum (chairman £25 extra). Secretary (*pro tem.*): H. Hawkins. Registered office: Gloucester Mansions, Cambridge Circus, W.C.2.

Bell Battery and Accessories Co., Ltd. (189,996).—Private company. Registered May 16th. Capital, £1,000 in £1 shares. To carry on the business of manufacturers of dry and wet electric cells, electricians, manufacturers of, and dealers in electrical appliances and apparatus, &c. The first directors are:—O. W. Seligman, 52, New Broad Street, E.C., solicitor; L. Cornelis, 39, Wilson Street, E.C.2, manufacturer (managing director). Qualification, 1 share. Registered office: 39, Wilson Street, Finsbury Square, E.C.

Bay-Brooke Co., Ltd. (190,024).—Private company. Registered May 17th. Capital, £2,000 in £1 shares (1,500 ordinary and 500 6 per cent. cumulative preference). To carry on the business of manufacturers and repairers of and dealers in receiving and transmitting wireless, telephonic, and telegraphic apparatus, magnetic, electrical, and electro-chemical apparatus and equipment, &c. The first directors are:—M. Smith, Rogart House, Park Hill Road, Birmingham (director of Cuxson, Gerrard & Co., Ltd., and Maurice Smith & Co., Ltd.), manufacturing chemist; A. H. S. Colebrooke, 82, High Street, Harborne, Birmingham, electro-chemical engineer (director of Aladdin Lamps (Midlands), Ltd.). Qualification, 25 shares. Secretary: H. W. Woffinden. Registered office: Rogart House, 19, Park Hill Road, Harborne, Birmingham.

Wilmore's Wireless, Ltd. (190,099).—Private company. Registered May 18th. Capital, £1,200 in 1,000 participating preference shares of £1 and 4,000 ordinary shares of 1s. To carry on the business of manufacturers of wireless instruments, &c. The first directors are:—W. Wrentmore, 203, Old Road West, Gravesend, Kent (managing director); H. T. Barnfield, 31, Howberry Road, Thornton Heath. Qualification, 1 share. Registered office: 108, Victoria Street, Westminster, S.W.1.

Percy W. Rowe Commercial Vehicle Supply Co., Ltd. (190,008).—Private company. Registered May 16th. Capital, £8,000 in £1 shares (1,000 original cumulative 5 per cent. preference and 7,000 ordinary). To take over from P. W. Rowe, trading as the "Percy W. Rowe Commercial Vehicle Supply Co.," the business of a motor engineer and agent, wireless and electrical engineer, and garage proprietor, carried on at Cardiff. The subscribers (each with one ordinary share) are:—P. W. Rowe, 144, Marlborough Road, Cardiff, motor engineer; R. J. B. Benson, 24, North Road, Cardiff, electrical and mechanical engineer. The first directors are:—P. W. Rowe and R. J. B. Benson (permanent managing directors), W. Rowe (chairman), and S. A. Ponting Qualification of permanent managing directors, 1,000 ordinary shares; of other directors, 100 original preference or ordinary shares. Remuneration of permanent directors, £200 each per annum. Registered by Pearce, Wyatt & Co., 88-90, Chancery Lane, W.C

Jamieson, Duncan & Co., Ltd. (12,690).—Private company. Registered in Edinburgh May 16th. Capital, £1,000 in £1 shares. To carry on the business of electrical and mechanical engineers, manufacturers of, and dealers in machinery, apparatus, and appliances of all kinds, &c. The first directors are: J. Jamieson, 17a, Blythswood Square, Glasgow, engineer; J. Duncan, 17a, Blythswood Square, Glasgow. Solicitors: John & James Robertson, 104, West Regent Street, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Wireless Installations, Ltd.—Particulars filed of £1,000 debentures authorised May 2nd, 1923, charged on the company's property, present and future, including uncalled capital, the amount of the present issue being £600.

Chipping Norton Electric Supply Co., Ltd.—Debenture dated May 16th, 1923, to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Branch Nominees, Ltd., 15, Bishopsgate, E.C.2.

Webbs Crystal Glass Co., Ltd.—Mortgage on the Dennis Glass Works, Stourbridge; Medway Glass Works, Queenborough; and Royal Castle Glass Works, Hatton, Tutbury, Derbyshire, dated May 14th, 1923, to secure all moneys due or to become due from company to Lloyd's Bank, not exceeding £3,000.

Midland Electric Light and Power Co., Ltd.—Issue on May 14th, 1923, of £2,000 debentures, part of a series already registered.

Aerophones, Ltd.—Debenture dated May 2nd, 1923, to secure £500, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: J. M. Iles, c.o. Bank of Australasia, Threadneedle Street, E.C.; and A. A. Davidson, 13, Vallance Road, Alexandra Park, N.

Pirelli-General Cable Works, Ltd.—Satisfaction in full on May 3rd, 1923, of mortgage dated June 10th, 1921, securing £15,825.

Cesco, Ltd. (in voluntary liquidation).—E. Thomas, of Baltic House, Mount Stuart Square, Cardiff Docks, ceased to act as receiver or manager on May 9th, 1923.

A. & A. Electrical Co., Ltd.—G. E. Sendell, of 36, Walbrook, E.C., was appointed receiver on May 14th, 1923, under powers contained in debenture dated November 15th, 1921.

Yorkshire and District Electric Lamp Repairing Co., Ltd.—H. Cawood, of 68, Eyre Street, Sheffield, was appointed receiver and manager on May 11th, 1923, under powers contained in debentures dated November 29th and 30th, 1922.

Vactite Wire Co. (1919), Ltd. (156,012).—Return dated December 15th, 1922. Capital, £25,000 in £1 shares. 15,000 shares taken up. £3 paid. £14,997 considered as paid. Mortgages and charges, nil.

River Plate Electricity Co., Ltd. (75,569).—Return dated May 14th, 1923. Capital, £500,000 in 150,000 preference and 350,000 ordinary shares of £1 each. £150,000 preference and £347,013 ordinary taken up and converted into stock. £105,433 paid. £391,580 considered as paid. Mortgages and charges, £161,000 5 per cent. debenture stock (part of £250,000 authorised).

British L.M. Ericsson Manufacturing Co., Ltd. (79,061).—Return dated May 14th, 1923. Capital, £300,000 in 99,990 preference and 100,010 ordinary shares of £1 each. All shares taken up. £170,000 paid. £30,000 considered as paid. Mortgages and charges, £100,000.

CITY NOTES.

Anglo-Portuguese Telephone Co., Ltd.

The report for 1922, which is to be presented at the annual meeting to-day (Friday), states that the average rate of exchange was 3 27/32d. per escudo, and the rate at the end of the year 2 13/32d. The floating assets and liabilities in Portugal at the close of the year have been converted at the latter rate. The two figures for 1921 were 6¼d. and 5 7/32d. respectively. The capital expenditure for the year amounted to £48,492, as compared with £81,534. The profit and loss account shows an adverse balance of £6,607, as against a profit of £20,285 in 1921. After the payment of income tax and Corporation profits tax (£2,458), and providing for debenture interest and sinking fund (£7,136), the total loss for the year is £16,201. The year's revenue and expenses have been converted at the rate of 3 27/32d. per escudo. Expressed in currency the gross income was Es.3,815,421 (as against Es.2,757,466), expenses in Portugal were Es.2,221,182 (Es.1,583,771), and the trading profits Es.1,594,239 (Es.1,173,695), but in these accounts the sum of Es.896,367 has been charged against renewals, reducing the net trading profits to Es. 697,872.

The report contains a table showing the extreme fluctuations of the sterling value of the escudo. This was 45¼d. (average) in 1913, and fell by steps to 3 27/32 last year.

The Government in April last authorised a further increase in the company's rates conditional upon the wages of employés being increased by 75 per cent. Although the company has been able to meet, to some extent, the fall in exchange by increased rates, the benefits are not all realised in the year in which the increases are made. Thus, of the increase of April last only 18 per cent. applies to the current year, 79 per cent. to 1924, and 3 per cent. to 1925.

Mr. Charles Woolley, who had been a director since 1899, resigned the position of chairman in January, and Viscount St. Davids was elected in his place.

West India and Panama Telegraph Co., Ltd.

The directors' report for 1922 records a revenue of £81,357, and expenses of £88,926, resulting in a loss of £7,569. Crediting interest on investments this was reduced to £7,239. The debit balance at the end of 1921 was £77,911, and adding the 1922 loss and £384 loss on sale of an investment, there is a total debit balance of £85,534. Trade in the British West Indies continued stagnant, and the traffic receipts of the company suffered badly both from this and from the competition at Porto Rico by an American company. An increase in charges had been sanctioned but, owing to the difficulty of obtaining the consent of the Western Union Telegraph Co., this could not be brought into effect until January 22nd this year. The consent of the Western Union could only be obtained through the waiver of certain of the company's rights under the old agreement of 1871. This waiver means a loss in earnings of many thousands of pounds. The increased charges are to remain in force up to September 30th next; if the authority is not then renewed, the company, so far as can be foreseen at present, will be unable to continue working. It is understood that the Colonial Office has in contemplation the institution of a new and competitive service in the West Indies; there could not be any adequate return upon the large outlay of £360,000, and it is obvious that the establishment of such a service must inevitably lead to the liquidation of the company. Meeting: June 6th.

English Electric Company of Australia, Ltd.

This company held its annual meeting at the offices, 77, King Street, Sydney, on April 23rd. The directors' report then submitted for the year ending March 31st, 1923, contained the following statements:—In connection with the final removal of the switchgear department from Waterloo to Clyde, it has been necessary to utilise the gallery at present occupied by the staff. An administration building is being erected at a cost of £3,000 to house the drawing office staff, costing department and ledger clerks, who are thus being turned out. Severe depreciation has again taken place in the stock, and has been allowed for in the valuation just made. It is believed that prices cannot fall much lower, as the £ is now practically on a gold basis, and wages at the other side of the world seem to be back to almost pre-war rates. The Melbourne business (Weymouth's Ltd.) is in good shape and a satisfactory dividend is expected again,

for the year ending June 30th, 1923. Debentures amounting to £76,600 have been exchanged for shares and the capital of the company thus increased to £361,720. This operation considerably strengthens the financial position by converting creditors into shareholders. "Standard-Waygood, Ltd. (the shares in which are practically all held by the company and figure under 'Investments') has been particularly busy in spite of very keen competition. A London concern, Waygood Otis (Aust.) Pty. Ltd., has started business in Australia, although 35 years ago they sold their Australian business to the predecessors of this company. Whether they are legally entitled to enter this field has not yet been determined, but as the Standard-Waygood machine is an entirely different type, and will always be in demand for the highest class of building, the point is scarcely worth taking. Lift orders in hand, unfinished, amount to over £150·000 out of an order book total of about half-a-million, some big items of which, however, are on the point of completion and have helped the year's profit. The tremendous drop in values and low prices quoted for export by Europe and America has hit us all round but particularly in the transformer department. At considerable expense we initiated this industry in Australia employing returned soldiers who have been taught the work. There are only some half-a-dozen leading manufacturers in the world of this class of electrical machinery, and they were making good profits. Immediately upon our entering the field, importers dropped their prices 10 per cent. to 20 per cent., and since we booked our first order for the City Council two years ago, prices have come down 65 per cent. Not receiving any encouragement from our City Fathers, who are the biggest consumers of this type of apparatus in Australia, we may have to shut the department down until prices rise as they probably will if local competition is killed. We cannot pay Australian wages and compete with the female and unskilled labour of the home lands even with a total protection (natural and artificial) of over 50 per cent. Our costs are about 100 per cent. more. We have referred somewhat fully to this item because to some extent the other branches of our business have the same axe suspended over them. The Australian market is a very valuable one to European and American exporters, and were it not for the sympathetic attitude of our Federal Government through its Customs Department the outlook for all local manufacture would be black as midnight. Industries which have been proved vital to Australia are in danger of being swamped by a flood of more cheaply produced machinery. Just as it was the policy of Britain years ago to feed her armament makers and shipbuilders with regular orders at payable price, so that when the call came she might have the necessary machinery of production in going order, so must Australia see that her engineers are kept in the country ready for emergencies. For they are useless 'on the land,' and your farmer makes a poor mechanic when the pinch comes." Under all these circumstances the directors were pleased to be able to show a profit of £37,175 for the year, plus £17,251 brought forward, making £54,426, out of which a dividend at the rate of 10 per cent. per annum was recommended. The chairman of the company has been granted leave of absence for nine months to visit America and England, and confer with the Board of the English Electric Co., Ltd., on important business.

Electric Construction Co., Ltd.

The net profit for the year ended March 31st, 1923, after providing for debenture interest and £10,000 for depreciation, was £50,333 plus £22,073 brought forward. After paying the 7 per cent. preference dividend, it is proposed to pay a final dividend at the rate of 9 per cent. per annum on the ordinary shares (making a dividend of 7½ per cent. for the year) and a bonus of 2½ per cent. on the ordinary shares (all under deduction of income tax). There is to be transferred to general reserve fund (which will then amount to £160,000) £17,287, leaving to be carried forward £20,725.

"The volume of orders received during the past financial year, although showing a considerable improvement on the previous year, was still much under the productive capacity of the works. Prices, moreover, were lower, and the amount of gross profit therefore shows some contraction. As stated at last general meeting, a valuation had been made by the company's staff of the land, buildings, plant and machinery, which proved that the value of the fixed assets alone exceeded the amount standing in the balance sheet under the heading of 'Properties, Patents and Goodwill.' Accordingly the last two items now appear at the nominal value of £1."

Meeting: London, June 12th.

Havana Electric Railway, Light and Power Co.

The report for 1922 shows a gross revenue of $12,910,707 and a net income of $6,790,791. The net profit was $5,703,784, and from this was deducted $2,900,000 for contingencies and depreciation reserve, leaving a balance of $2,803,874, to which was added $3,781,040 brought forward, making $6,584,824. After providing for sinking funds in respect of the bonds of the Havana Gas & Electricity Co., the Havana Electric Railway Co., and the Havana Electric Railway, Light & Power Co., dividends of 6 per cent. have been paid on the preferred and common stock, absorbing $2,155,261, and a balance of $3,861,660 is carried forward.

Whitehall Electric Investments, Ltd.

The first annual report, covering the year ended March 31st last, shows that the gross income was £538,763. After deducting expenses, debenture interest, income tax, and corporation profits tax, the net income was £318,786. The revenue approximated very closely to the estimate made in the company's prospectus.

The preference dividend requires £112,500, and the preliminary expenses in connection with debenture stock, amounting to £106,286, are written off. It is proposed to utilise the balance (£100,000) to pay a dividend of 2 per cent. upon the ordinary shares.

It is stated in the report that all the undertakings in which the company has interests have progressed satisfactorily. The meeting is to be held to-day (Friday).

Cawnpore Electric Supply Corporation, Ltd.

Mr. J. G. B. Stone (chairman), speaking at the annual general meeting on May 23rd, said that the accounts did not disclose the true position, as they covered the period of transition from the closing-down of the old station and the opening of the new one. The profits were lower by £4,200, and the 10 per cent. dividend was being maintained by withdrawing £2,348 from reserve. During the year a further issue of £250,000 five per cent., tax free, debentures had been made, and £34,300 of the six per cent. debentures had been converted, leaving a balance of £15,300 six per cents. An addition of £172,858 had been made to the capital expenditure by the construction of the new station and the laying of mains. The riverside station contained two 3,000-kW turbo-generators, and provision for two 6,000-kW sets was being made. The new station would considerably reduce working costs. The small tramway had had a bad year—some £1,300 worse than 1921.

German Companies.

The *Accumulator Works Co.*, of Berlin and Hagen, proposes to pay a dividend at the rate of 25 per cent. for 1922, being the same as in the preceding year.

The *Mix & Genest Telephone Works Co.*, of Berlin, intends to distribute a dividend at the rate of 150 per cent. for 1922, as contrasted with 16 per cent. in the previous year.

The *United Insulator Works Co.*, of Berlin-Pankow, intends to pay a dividend at the rate of 100 per cent. out of net profits of 13,840,000 marks in 1922, this result comparing with 12 per cent. and 430,000 marks respectively in 1921.

The *Electrical Undertakings Co.*, of Berlin, which is an investment concern, reports net profits of 342,076,000 marks for 1922, as contrasted with 17,339,000 marks in the previous year. The rate of dividend is to be increased from 20 per cent. in 1921 to 100 per cent. last year.

The *Hartmann & Braun Co.*, of Frankfort-on-Main, proposes to pay for 1922 a dividend at the rate of 50 gold pfennigs per share, or 300 per cent., as contrasted with 25 per cent. in the previous year. The net profits are returned at 219.57 millions of marks, as compared with 2.46 millions in 1921.

The *Dr. Paul Meyer Co.*, of Berlin, after having made provision for depreciation, reports net profits of 157,000,000 marks for 1922, as compared with 6,500,000 marks in the previous year. It is proposed to pay a dividend at the rate of 150 per cent. as against 15 per cent. in 1921. The turnover in the first four months of 1923 is stated to have been four times the amount in the whole of 1922.

The report of *Voigt & Haeffner*, of Frankfort-on-Main, states that it was frequently not possible to execute the rush of orders in 1922, despite the partial completion of the new buildings. After writing off 109.68 millions of marks for depreciation, as against 1.62 million in 1921, the accounts show net profits of 238.10 millions (13.53 millions in 1921). The directors recommend a dividend at the rate of 150 per cent., as compared with 20 per cent. in the previous year.

Swiss Companies.

The *Alioth Electricity Co.*, of Basle, after having written off 120,000 fr. for depreciation, reports net profits of 342,000 fr. for 1922, and a dividend at the rate of 5 per cent. These figures compare with 343,000 fr., and 5 per cent. respectively in 1921.

The *Swiss Electrical Industry Co.*, of Glarus, reports a gross profit of 2,040,000 fr., which, after meeting general expenses, taxes, &c., permits of the deficit from 1921 being reduced to 740,000 fr. It is now proposed to reorganise the finances of the company in connection with depreciated investments held in low currency countries.

The directors have issued a proposal to the shareholders to reduce the capital to the extent of 60 per cent. by writing down the value of the ordinary shares issued from 4,000,000 to 1,600,000 fr., and the preference shares from 56,000,000 to 22,400,000 fr. It is also proposed that the undertaking to repay the preference shares in 1940 shall be cancelled, as also the existing rights over the ordinary shareholders.

French Companies.

The *Société Gramme* proposes to pay a dividend at the rate of 57.50 fr. per share for 1922, out of net profits of 534,000 fr. This result compares with 55 fr. and 698,000 fr. respectively in 1921.

The *Compagnie Electro-Mécanique* records net profits of 5,532,000 fr. for 1922, or slightly more than the 5,482,000 fr. realised in the previous year. It is intended to maintain the rate of distribution at 40 fr. per share as in 1921.

The *Société de Télégraphie sans Fil* proposes to pay a dividend at the rate of 40 fr. per share out of net profits of 5,447,000 fr. in 1922. The same rate was paid for 1921, when the net profits were 4,967,000 fr.

The *Compagnie Francaise Thomson-Houston* reports an increase in the gross profits from 35,435,000 fr. in 1921 to 37,584,000 fr. last year. After having defrayed general expenses, interest charges, and allocated 2,462,000 fr. to depreciation and reserves, the accounts show net profits and balance forward amounting to 20,821,000 fr. as against 20,620,000 fr. in 1921. As in the latter year, the rate of dividend is to be 45 fr. per share for 1922.

Westinghouse Electric and Manufacturing Co.

The net income for the year ending March, 1923, was $12,263,485. The dividend requirements were $6,033,428, so that over twice this amount was earned and more than six million dollars added to the surplus. Gross sales for the year were $125,000,000, which represents an increase of $25,000,000 over the sales of last year. The bookings of new business steadily increased during the year, states Mr. Guy E. Tripp, chairman, "and the value of unfilled orders at the close of the year was $61,914,237, as compared with $50,740,696 at the close of the previous year." Under the company's insurance and savings plan, two-thirds of the employés own insurance of $500 or more each. The deposits by the employés in the savings fund are accumulating at a rate in excess of $100,000 a month, and the total savings to date are in excess of $2,000,000. The savings are invested for the benefit of the employés and are not used in any way in the company's operations. A plant located at Sharon, near Pittsburg, Pa., was acquired during the year, and it is planned to concentrate the manufacture of transformers there.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159:—

American Telephone and Telegraph.—$10,481,800 common stock.

Application has been made to the Committee to allow the following to be officially quoted:—

American Telephone and Telegraph Co.—$10,481,800 capital stock.

Metropolitan District Railway Co.—£500,000 5 per cent. redeemable debenture stock, 1933-1943.

Charing Cross, West End & City Electricity Supply Co., Ltd.—The directors are about to issue 16,000 ordinary shares of £5 each, forming part of the unissued ordinary capital of the company, at the price of £7 10s. per share. These shares will be offered to the holders of the ordinary shares as registered on June 2nd, 1923, the holder of each complete five shares being offered one new ordinary share.

Automatic Telephone Manufacturing Co., Ltd.—Profit for the year 1922, £42,258. The dividend on the preference shares is paid, and £6,487 carried forward. No divided on the ordinary shares.

International Automatic Telephone Co., Ltd.—Profit for 1922, £15,908. The dividend on the preference shares is paid, and £2,755 carried forward. No dividend on the ordinary shares.

Yorkshire (West Riding) Electric Tramways, Ltd.—Interim dividend of 3 per cent. on the 6 per cent. cumulative preference shares.

Mirrlees, Bickerton & Day, Ltd.—The net profit for 1922, after providing for depreciation and directors' fees, was £22,523. To this is added £2,858 brought forward, making £25,381. The preference dividend already paid absorbed £1,464, and it is proposed to allocate the balance as follows:—Dividend of 7½ per cent., less tax on the ordinary shares; £5,000 to reserve; £3,390 carried forward.

Reduction of Capital.—ELECTROMOBILE, LTD. AND REDUCED.—A petition for the confirmation of the reduction of capital of the company from £40,000 to £25,000 has been presented to the High Court, and will be heard in London on June 12th.

Canadian General Electric Co., Ltd.—A quarterly dividend of 1¾ per cent. for the three months ending June 30th, 1923, on the common stock is announced.

STOCKS AND SHARES.

TUESDAY EVENING.

DOMESTIC politics are held to be the reason for the comparative indifference with which the public treats Stock Exchange markets at the present time. The investment sections are good, with noticeable demand for anything which may strike popular fancy, as, for instance, Charing Cross Electric shares, on the announcement of the new issue at a bonus price, but in the general run of markets there is nothing much doing, and the settlement which concluded on Thursday in this week yielded poorly in the matter of commission to brokers and turns to jobbers. The rush of new issues is to some extent stayed, but the appetite of the investor remains keen, and in nearly every case where a premium developed after allotment, the price is better than it was.

The Charing Cross Company's offer just mentioned is of sixteen thousand new ordinary shares of £5 each, to be subscribed at £7 10s. each, in the proportion of one new share for every five at present held. This gives a substantial bonus to the shareholders, and is, of course, free of tax. The price improved 15s. to 12 as a result. Shareholders in other electricity supply companies are asking whether similar good fortune is likely to be visited upon them. It is also hoped that the process of converting £5 shares into others of £1 each will be extended by the inclusion of the Charing Cross Company after this new issue has been made, and the shares are comfortably placed in the hands of proprietors.

City of London ordinary have risen to 47s. 6d., and Kensingtons at 9 are 5s. better. St. James' preference strengthened to 6. Bournemouth and Poole, after changing hands at 31s., advanced to 32s. A Stock Exchange Mark Tapley said he was glad to hold County of London ordinary, considering the weather. Westminsters hold their strength at 9¼. Whitehall preference have gone up to 20s., and the 6 per cent. debenture to 96, upon the issue of a report which has the rather rare virtue of showing that prospectus-promise can be excelled in actual performance.

Edison Swan 5 per cent. debenture is a couple of points better at 66, the high yield of 7¾ per cent. offered by the stock having attracted attention. The ordinary shares remain at 4s. 3d. middle. Siemens have hardened to 17s., and the 10 per cent. preference to 24s., apparently on the speech of the chairman at the recent meeting. Possibly, however, there were bears in the market. The 4½ per cent. debenture stands about 85. General Electrics rose to 20s. 6d. Babcock and Wilcox at 43s. are easier now that the immediate effect of the share-splitting has worn off, and a few speculative buyers have been taking their profit.

Mexicans, after their very substantial rises, show an inclination to halt. The Tramways 5 per cent. bonds at 85½ are a point to the good, and Mexican Light common rose 3, though the latter company's bond issues are both easier. Political events in Mexico do appear at last to be shaping in a definite direction towards a settlement, and recognition of the country by its affluent northern neighbour. Anglo-Argentine Tramways second preference have recovered to 3, the speculative purchaser arguing that it can be only a matter of time before the Buenos Ayres Municipality comes to some sort of a compromise with the Tramways Company in the matter of fares.

British Electric Traction ordinary responded with a gain of 3, to 77½, upon declaration of a final dividend, making 5 per cent., as against 4½ per cent. a year ago. The announcement will come as no surprise to those who follow these weekly notes. At par, the preference stock shows no change. London Traction issues are also unaltered. Central London Assented ordinary is a point higher at 74. This company's unassented stocks are quoted 55½, 58½ and 53½ for ordinary, preferred and deferred respectively. The guaranteed assented preference is the same price as that of the guaranteed ordinary, 74, and the guaranteed deferred commands a point less.

The cable group is quiet with a rise of ¼ in Globe preference, and a fall of the same amount in Western Telegraphs. West India and Panama shares have dropped to a nominal 2s. 6d., on the issue of a report which takes a gloomy view of the outlook, and which shows that the preference arrears now amount to over £82,000, while the profit and loss account shows a debit of £85,500. In addition to this, the Government threatens a competitive service in the British West Indies at a cost of £360,000, which, if put into force, would seem to be a most unfair step towards the West India & Panama Co., besides being an unnecessary duplication of cable service. The first and second preference shares have received no dividend since November, 1919. Their prices have dropped to £1 each. The company's 5 per cent. debentures are quoted about 80.

In the wireless market, Marconis have sagged to 2 5/16. The Anglo-Portuguese Telephone Co. did more business, but took less money, than in the previous twelvemonth, the present account showing a loss of £16,000, against a profit of £10,000 in 1921. The results are due to the depreciation of the escudo. It may be noted that the cut in rates for cablegrams to New York, and other North Atlantic stations served by the Western Union Telegraph Co., came into force on the Wednesday in this week.

The Electric Construction Company has declared a dividend on the ordinary shares, making 7½ per cent., together with a bonus of 2½ per cent., all less tax, being at the same rate as for the previous year. Coincidence and accident, in this being mentioned here a month ago as the dividend on the shares, are shown to have been merely premature. Cromptons are ¼ down at 12s. 6d. An issue of 150,000 6 per cent. preference shares at 20s. is on the point of being made by the Electric Supply Corporation.

The rubber market is unsettled, owing to the fluctuations, narrow but frequent, in the price of the produce, and the market for armament shares shows little alteration on the week. Electric and General Investment preference at 3½ are 10s. up. Other rises of the week include Victoria Falls ordinary and preference, the prices of both shares having risen to 29s. 3d. upon persistent purchases.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price May 29. 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	26/6	—	£6 11 4
Charing Cross Ordinary ...	5	9	14	12	+ ¾	5 16 8
do. do. do. 4½ Pref.	5	4½	4½	4¼	—	5 6 0
Chelsea	1	6	10	1¾	—	5 14 3
City of London	1	14	15	2¾	+ 3/32	6 6 4
do. do. 6 % Pref. ...	1	6	6	23/-	—	5 4 4
County of London	1	8	10	38/9	—	5 3 3
do. do. 6 % Pref. ...	1	6	6	23/-	—	5 4 4
Edmundson's Ordinary	3	Nil	—	2½	—	Nil
do. 6 % Pref. ...	5	12/-	—	4¼	—	6 8 0
Kensington Ordinary	5	10	12	9	+ ½	6 13 4
London Electric	8	4	10	4¾	—	6 5 6
do. do. 6 % Pref. ...	5	6	6	5¼	—	5 17 1
Metropolitan	1	7	8½	29/-	—	5 17 4
do. 4½ % Pref.	1	4½	4½	18/-	—	5 0 0
Newcastle-on-Tyne Ordinary ...	1	Nil	2½	7/8	—	2 17 2
do. 5 % Pref. ...	1	5	5	16/3	—	6 3 1
do. 7 % Pref. ...	1	7	7	24/6	—	5 14 2
Notting Hill, 6 per cent. Pref....	10	6	6	9¾	—	6 9 9
North Met. Elec., 6 % Pref. ...	1	6	6	1 1/8	—	5 18 0
Urban Ordinary	3	Nil	—	1⅝	—	Nil
do. 5 % Pref. ...	5	2½	—	4½xd	—	5 11 1
St. James' and Pall Mall ...	5	12	14½	11	—	6 11 10
South London	1	7	10	1¾	—	5 14 3
South Metropolitan Pref. ...	1	7	7	1¼	—	5 12 0
Westminster Ordinary	5	10	12	9¾	—	6 3 1
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	20/-	+ 6d.	7 10 0

Home Rails.

Central London Ord. Assented	Stock	4	4	74	+1	5 8 1
Metropolitan	,,	2¼	3½	73	—	4 16 0
do. District	,,	1	3	55½	— ½	5 8 1
Underground Electric Ordinary	10	Nil	Nil	9¼	—	Nil
do. do. "A" ...	1	Nil	Nil	8/6	—	Nil
do. do. Income	Stock	4	5	97½	+ ½	*5 2 7

Telegraphs and Telephones.

		Dividend. 1920.	Dividend. 1921.			
Anglo-Am. Tel. Pref.	Stock	6	6	104½	—	5 14 10
do. Def.	,,	1½	34/6	23	+ ¼	6 10 5
Chile Telephone	5	6	6	6¾	+ ¼	4 18 0
Cuba Sub. Ord.	10	7	7	7½	—	9 6 8
Eastern Extension	10	10	10	18⅝	—	5 6 8
Eastern Tel. Ord....	Stock	10	10	187½	—	5 6 8
Globe Tel. and T. Ord.	10	10	10	19	—	5 5 3
do. do. Pref.... ...	10	6	6	11⅝	+ ¼	5 2 2
Great Northern Tel.	10	24	32	80	—	7 5 6
Indo-European	25	10	7	81½	−1	5 11 1
Marconi	1	25	15	2 3/8	— 1/32	6 9 10
Oriental Telephone Ord. ...	1	12	12	25	—	*4 8 6
United R. Plate Tel.	5	8	8	7¼	—	*5 10 4
West India and Panama ...	10	Nil	Nil	3/9	— ¼	Nil
Western Telegraph	10	10	10	18⅝	— ¼	*5 7 5

Home and Foreign Trams, &c.

Anglo-Arg. Trams. First Pref.	5	5½	12½	8 7/8	—	8 6 0
do. do. 2nd Pref.	5	Nil	5½	3	+ 1/16	9 3 4
do. do. 5 % Deb.	Stock	5	5	82½	—	6 1 3
British Electric Traction Ord.	,,	4½	5	77½	+3	6 9 0
do. do. 6 % Pref.	,,	6	6	100	—	6 0 0
Brazil Tractions...	100	Nil	Nil	51	—	7 16 10
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	80½	+2	5 11 9
do. do. Preferred	,,	5	92/-	78½	—	*6 0 0
do. do. Deferred		8	124/-	87½	−1	*6 19 9
do. do. Deb. ...	,,	4½	4½	81	—	5 5 0
Lond. & Sub. Trac. 5 % Pref.	1	2½	3½	11/-	—	9 2 0
London United Tram. Deb. ...	Stock	4	4	65½	—	6 2 2
Mexico Tram. 5 % Bonds ...	—	Nil	Nil	35½	+1	5 17 0
do. 6 % Bonds ...	—	Nil	Nil	62½	—	Nil
Mexican Light Common ...	100	Nil	Nil	34½	+3	Nil
do. Pref.	100	Nil	Nil	60½	−1	Nil
do. 1st Bonds ...	—	Nil	5	75½	−1	6 12 5

Manufacturing Companies

Babcock & Wilcox	1	15	20	2 7/32	— 1/32	4 10 1
British Aluminium Ord. ...	1	10	5	20/9	—	4 16 5
British Insulated Ord.	1	15	15	2½	—	6 0 0
Callenders...	1	15	15	2 5/16	—	6 8 0
do. 6% Pref.	1	6½	6½	23/-	—	5 13 1
Crompton Ord.	1	10	5	¾	— ⅛	8 0 0
Edison-Swan	1	10	Nil	4/8	—	Nil
do. do. 5 % Deb.	Stock	5	5	66	+2	7 11 6
Electric Construction	1	10	10	28/9	—	6 19 2
English Electric	1	8	5	17/6	—	5 14 3
do. do. Pref.	1	6	6	20/6	—	5 17 1
Gen. Elec. Pref.	1	6½	6½	23/9	—	5 9 5
do. Ord.	1	10	5	20/6	+1/-	4 17 7
Henley	1	15	15	2 1/8	—	6 8 0
do. 4½ Pref.	5	4½	4½	4½	—	5 0 0
India-Rubber	1	10	—	½	—	—
Met.-Vickers Pref.	2	8	8	2½	—	6 8 0
Siemens Ord.	1	10	10	17/-	+9d	Nil
Telegraph Con.	12	20	20	28½	—	*4 16 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS FOR CHEMICALS AND METALS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.	Price May 30th.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	6¾d.	...
a Ammoniac, Sal ... ... per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£62	£1 inc.
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£28	...
a Copper Sulphate ... ... ,,	£26 15s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4¼d.	...
a ,, Perchlorate ... ... ,,	5d.	...
a Shellac ... ... per cwt.	£15 10s.	£1 dec.
a Sulphur, Sublimed Flowers ... ,,	£9	...
a ,, Roll ... ... ,,	£8 10s.	...
a Soda, Chlorate ... ... per lb.	3d.	...
a ,, Crystals ... ... per ton	£5 10s.	...
a Sodium Bichromate, casks ... per lb.	4½d.	...
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£115 to £120	...
b ,, Wire ... ... per lb.	1/9 to 2/6	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		...
Grade I ... ... per ton net	£152	...
Grade II ... ... ,, ,,	£120	...
Grade III... ... ... ,, ,,	£78	...
c Brass (rolled metal 2" to 12" basis) per lb.	10½d.	...
c ,, Tubes (solid drawn) ... ,,	1/0½ to 1/0½	½d. dec.
c ,, Wire, basis ... ... ,,	10½d.	...
c Copper Tubes (solid drawn) ... ,,	1/2d.	½d. dec.
c ,, Bars (best selected) ... per ton	£100	£4 dec.
c ,, Sheet ... ... ,,	£100	£4 dec.
c ,, Rod ... ... ,,	£100	£4 dec.
d ,, (Electrolytic) Bars ... ,,	£74 10s.	50/- dec.
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, Wire Rods ,,	£84 10s.	50/- dec.
d ,, ,, H.C. Wire per lb.	10½d.	½d. dec.
f Ebonite Rod ... ... ,,	3/6	...
f ,, Sheet ... ... ,,	3/-	...
n German Silver Wire ... ... ,,	2/3	...
h Gutta-percha, fine ... ... ,,	6/6	1/- inc.
h India-rubber, Para fine ... ... ,,	1/2	...
l Iron Pig (Cleveland Warrants) ... per ton	92s. 6d.	...
l ,, Wire, galv. No. 8, P.O. qual. ,,	£25	...
g Lead, English Pig ... ... ,,	£27	15/- inc.
g Mercury ... ... per bot.	£10 10s. to £10 15s.	10/- to 12/6 inc.
e Mica (in original cases) small ... per lb.	3d. to3/-	...
e ,, ,, medium... ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/2	...
p ,, drawn bars and rods ,,	1/4	...
p ,, rolled strip & sheet ,,	1/3½	...
p ,, wire ... ... ,,	1/4½	...
o Platinum ... ... per oz.	£23	...
d Silicium Bronze Wire ... ... per lb.	1/1½	½d. dec.
r Steel, Magnet, in bars ... ... ,,	10d.	...
n Tin, Block (English) ... ... per ton	£200 to £203 10s.	£6 10s. inc.
n ,, Wire, Nos. 1 to 16 ... ... per lb.	3/-	...

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Arc Welding in the Foundry.—Mr. A. M. Candy, of the General Engineering Department., Westinghouse Electrical and Manufacturing Co., states that one of the most recent applications of arc welding in foundry practice is that of repairing the lugs of flasks when the holes are worn to such a large diameter that the pins on the other half of the flask will not fit tightly enough to hold the parts in good alignment. The practice in the past has been to ream out the hole to a diameter of ¾ in. and then press in a bushing having a hole of the right diameter, namely, ½ in. The new method is to ream out the hole to ¾ in. diameter and then fill it completely, using the metallic-electrode arc-welding process. A piece of copper is placed under the hole and the welding is done, using about 175 amperes and 5/32-in. diameter welding wire. The time required to weld one hole is about three minutes. A ¾-in. hole is drilled in the casting, although only a ½-in. hole is required for the pin on the flask, because there is a layer of very hard chilled high-carbon cast steel about 1/16 in. thick in the region where the deposited metal unites with the casting; therefore it is necessary to have the original hole ¼ in. larger in diameter than the final hole, so that no difficulty will be experienced in drilling the final hole through the deposited metal. When the holes are again worn oversize it is not necessary to ream them out before the welding operation. The time required to weld a hole is then reduced to about two minutes. The cost of the operation is trifling.

Golf.—Teams representing the electricity departments of Glasgow and Edinburgh met recently in Glasgow and the match resulted in an easy win for Glasgow by 12 matches to 3. One game was drawn.

NATIONAL DIPLOMAS AND CERTIFICATES IN ELECTRICAL ENGINEERING.

The joint issue by the Institution of Electrical Engineers and the Board of Education of National Diplomas and Certificates in Electrical Engineering is an advance of educational and industrial significance. It is a new association, a new link between scientific industry and education which should prove fruitful in good results to all concerned.

Education for the profession of electrical engineering is carried on in several grades and in different ways. In the technical faculties of the Universities and in the larger technical colleges it consists of full-time day courses extending over two, three, and in some cases four years. Further forms of education are to be found in the part-time day courses in technical schools held on one day a week for 40 weeks per annum over a period of from three to five years. Such courses are largely attended by selected apprentices from important engineering firms. There is also a network of evening courses extending over the industrial areas of the country. These courses are held on three evenings a week for about 30 weeks per annum over a period of from three to five years.

The work of the Universities speaks for itself, and it is an encouraging fact that the possession of a degree in engineering is now regarded as a desirable qualification for entry to industrial work. With regard to the other modes of training to which reference has been made, it may be said that, although they are more modest in their aim and more restricted in the character of the training given than is a University degree course, yet they afford to a large number of persons the only avenue of approach to the higher technical posts in industry that means and circumstances permit.

Prior to the establishment of the scheme for national certificates and diplomas in electrical engineering, there existed outside the Universities no scheme of certification which was internal in character and at the same time was current over the whole country. Many of the technical colleges and schools have established reputations for their diplomas and certificates which are well known locally, while a few have succeeded in building up reputations which are recognised over a wide area.

A good deal of difference existed in the standards upon which these awards were made, and it was almost impossible for an employer in London correctly to appraise the value of a certificate issued by a technical school, let us say in Lancashire, of which the employer knew nothing beyond its location, or for a works manager in the Midlands or the North to evaluate a certificate emanating from a school in the Metropolis.

The new scheme of national diplomas and certificates meets this need by supplying standards of various grades which are current all over England and Wales, and are vouched for by the Institution of Electrical Engineers in conjunction with the Board of Education. The awards under this scheme testify to the attainment of definite minimum standards of knowledge, but they do more than this, they imply that the candidate has successfully passed through a specified course of training of definite duration in a school or college in which the curriculum, staff, and equipment have been specially approved for the purpose.

Further, the candidate is judged not only by his performance at the examinations, but also on the work done in the class-room, the laboratory, and the drawing office in each of the years of the course pursued at the technical school.

In order to obtain a certificate or diploma, a candidate must make not less than 60 per cent. of the possible attendances in each year of the course, and must obtain not less than 40 per cent. of the possible marks in each subject of the final examination. Not less than 40 per cent. of the possible marks in the final year for home-work, class work, laboratory work, &c., taken separately in each subject for which such marks are awarded under the approved scheme. Not less than 50 per cent. of the grand total of marks obtainable in the final year. Of this total the possible marks in the final examination constitute 70 per cent., and the remaining 30 per cent. is allocated to the marks for home-work, class work, laboratory work, &c., of the final year. Distinctions are awarded to candidates qualified to receive a certificate or diploma who gain not less than 85 per cent. of the possible marks in the final examination in any subject, and such successes may be specially endorsed on the certificate or diploma.

The scheme possesses a further advantage in that the examinations contain an internal element. In the earlier years of the courses, the examination papers are set and marked by the teachers of the schools concerned, but in the final year of each course the papers, as drafted by the teachers, are sent in the first place to the Institution of Electrical Engineers, there to be scrutinised and modified by special assessors appointed by the Institution for this purpose. The assessors have the option of substituting questions up to 40 per cent. of the total questions set, and may make any question compulsory, provided that the number made compulsory does not exceed about 40 per cent. of the number to be answered. The examination papers are then worked by the candidates and marked by the teachers of the schools concerned, and the marking by the teachers of the papers worked in the final examinations is subject to revision by the assessors of the Institution of Electrical Engineers.

Certificates are awarded in respect of part-time grouped courses, and diplomas in respect of full-time grouped courses.

Part-time courses for purposes of a certificate are classified as follows:—

(1) *Senior* courses adapted to the needs of students who have passed through a two-years' junior part-time course, or who have had a full-time continuous education up to the age of 15 or 16 years. Senior courses normally extend over three years. Certificates relating to senior courses are termed "ordinary certificates."

(2) *Advanced* courses adapted to the needs of older students which aim at reaching within the limits of the subjects covered by them the standard of University work. Certificates relating to advanced courses are termed "higher certificates."

Full-time courses for purposes of a diploma are classified as follows:—

(1) *Senior* courses suitable for students who have had full-time continuous education up to the age of 16 years. A senior full-time course must extend over two years, and diplomas relating to it are termed "ordinary diplomas."

(2) *Advanced* courses suitable for students who have had full-time continuous education up to the age of 17 or 18 years, or for students who have been for two years in regular employment with concurrent instruction in senior or advanced part-time courses. An advanced full-time course must extend over at least two years, and the related diplomas are termed "higher diplomas."

British Science Guild.—An appeal signed by Lord Askwith, president of the British Science Guild; the Marquis of Crewe, vice-president; Sir R. A. Gregory, the Hon. Sir C. A. Parsons, Sir W. H. Bragg, Sir J. J. Thomson, and Sir R. A. Hadfield has been issued asking for £50,000, which is required to enable the guild to carry on its programme. The guild, it is said, seeks to promote the application of scientific methods to all public affairs, to bring matters of scientific interest before the great mass of the people, and, by awards, to offer recognition to scientific work of prime importance. Donations should be sent to 6, John Street, Adelphi, W.2. New members will be welcomed.—*Daily Telegraph.*

DIFFICULTIES EXPERIENCED IN THE WIRING OF HOUSES.

The Relations between Landlord and Tenant.

By R. E. GAMLEN.

In many cases potential consumers are baulked by the fact that they do not own the houses in which they live. The argument they put forward is that, should they move within a certain time, they get no return for the capital expenditure entailed—in other words, they are investing money which they may not be able to enjoy to the full extent. This objection is unfortunately fundamentally sound, and it is somewhat difficult to devise a scheme whereby it may be obviated, since any negotiations for the alleviation of this objection must necessarily be made through the landlord. It must be pointed out, however, that it is a matter that would well repay investigation, and any scheme put forward should be welcomed.

Broadly speaking, the tenants may be placed in four main groups:—

(*a*) Those who have leased their home for a number of years.

(*b*) Those who have leased their home for only two or three years.

(*c*) Those who may leave it at any time.

(*d*) Those occupying cottages on monthly notice.

Dealing with group (*a*), this class, as a rule, is fairly easy to convince—if it be pointed out that within four years the additional economies effected, due to the absence of dirt, and hence the abolition of the need to redecorate so often, will easily offset the money expended on wiring the premises. In cases where the lease does not run out for over ten years, the house may be regarded as though it were privately owned, and the usual arguments present themselves.

(*b*) This class presents a clear case for some arrangement between the landlord and tenant. It is obvious that if the present occupier leaves within two years of wiring the home, the incoming tenant will not agree to pay for the installation, although payment for fittings is generally arranged, the argument put forward being that as the wiring was done by the previous tenant, he is at liberty to remove it (it being obvious that the cost of removal would be more than the scrap could fetch). The landlord should therefore be consulted and the position pointed out, in conjunction with the tenant, on the following terms:—

If the tenant wires the house and does not leave for five years, he has made enough use of the supply to enjoy the full economies, so that only a lesser period need be considered. The landlord, owing to the increased value of his property and the possibility of increased rent, should be willing, in the event of his tenant leaving within the period of five years, to allow a sum of money for the installation, less an allowance for depreciation.

The percentage of depreciation only remains to be fixed. As five years has been taken as the benefit period, depreciation should be fixed at a rate of 20 per cent. per annum. If the house were vacated in three years and the tenant paid £50 for his wiring, the amount he would receive would be £20 from the landlord.

It is thought that if a scheme were prepared on these lines, and both landlord and tenant circularised, an appreciable number of new consumers should be acquired.

Class (*c*) can be dealt with in the same way as (*b*), except that the depreciation should be somewhat lower.

Class (*d*) should be dealt with by the landlord, and a slightly higher rent charged for five years.

To sum up the whole question, there is little doubt that negotiations between landlord and tenant would be simplified if some scheme such as that suggested were drawn up, because so few landlords like to approach their tenants, and *vice versa*, while if the supply authority could act as an intermediary many of the inherent difficulties could be overcome.

RECONSTRUCTED FRANCE.

(NEW INDUSTRIAL STRENGTH.)

A comprehensive and highly interesting report by H.M. Commercial Counsellor in Paris (Mr. J. R. Cahill) has just been issued by the Department of Overseas Trade. Mr. Cahill surveys in an admirable manner the new position which France has attained in her metallurgical and engineering industries. For example, she is now the greatest ore country in Europe; her control of the Sarre coal mines gives her about one million tons of coal a month; great metallurgical works in the re-annexed territory now add their output to the sum of existing French production, the capacity of which had already been greatly increased since 1914.

Among the changes of a permanent character affecting importation the report mentions the development of the manufacture of certain steels, electrical equipment and textile machinery.

A very striking phase of the restoration of French industries is that it has been accompanied by widespread modernisation of plant, and therefore, by a great increase in efficiency. Up-to-date equipment of various kinds for the mining and handling of coal has been installed in the Nord and Pas de Calais fields, where the output has recovered to about 50 per cent. of its pre-war level.

Increased Competitive Power.

The competitive power of French industry has been further strengthened by a degree of organisation which recalls the grouping that has taken place amongst German manufacturers. Mutual interests exist between several of the groups, *e.g.*, between Schneider and de Wendel, whilst these two, as well as the Cie. des Forges et Aciéries de la Marine et d'Homécourt (St. Chamond), have interwoven interests, into which Belgian works have entered in Luxemburg. The companies have also secured control as a rule of the sources of their chief raw materials, and obtained control of, or interests in, concerns which are users of their products. The Schneider concern owns or has this participation in coal and ore mines, iron and steel works, firms making ships, electrical machinery and apparatus, guns, dredgers, machine tools, boilers, optical and scientific instruments. Its international extension in some cases is also considerable, not only in Luxemburg and Belgium, but also in Czecho-Slovakia, Austria, Rumania, and Poland.

Mr. Cahill does not fail to remark that the electrical industries, the influence of which is growing considerably in France as a consequence of the progressive use of electric power, afford another illustration of the tendency towards consolidation or combination. It may be affirmed, he says, that this industry on its productive side is controlled by only a small number of firms, that the producing firms have bonds of interests or of persons, and that even as regards distribution the producing companies are almost inextricably intertwined with a large proportion of the distributing companies.

An appendix to the report gives a very detailed account of the vast ramifications of the big metallurgical and electrical groups, the numerous lines of manufacture in which they are engaged, the situation of their various works, and their interest in either branch works in neighbouring countries or home and foreign concerns consuming their products.

Railway Electrification.

The electrical trade has been one of the most prosperous in the engineering group in recent years. The report mentions the notable development that several firms are engaged on in the construction of electric locomotives for main line electrification. The State railway proposes to electrify its various suburban lines from Paris (St. Lazare), but the present programme applies mainly to the three systems, the Southern (Midi), the Paris-Orléans, and the Paris-Lyons-Mediterranean; the total length to be electrified amounts to 8,839 kilometres (about one-third of the length

of the French systems), and the annual consumption will, it is estimated, amount at the outset to 1,180 million kilowatt-hours and will rise to double that figure. At the present time most progress has been made by the Southern Railway in the electrification of the line from Tarbes to Bayonne (165 kilometres) and to Dax; it derives its power from its own power stations in the Pyrenees. The Paris-Orléans, which electrified about twenty years ago its suburban lines, will electrify the stretch Paris-Orléans-Vierzon with branch Brétigny-Dourdan (230 kilometres) as the first part of its definite programme covering 3,300 kilometres; its power will be mainly obtained from the river Dordogne. The Paris-Lyons-Mediterranean Railway proposes to electrify 326 kilometres in the neighbourhood of Paris and 3,000 kilometres in the region of the Rhône, which will supply its power. The estimated cost of the above schemes is put at over five milliard francs, of which 1.83 milliards is assigned to power works and feeders; 1.4 milliards to equipment of the permanent ways and of the sub-stations; and 1.8 milliards to electric locomotives. Uniformity for the whole country is being enforced; three-phase 50-cycle current, with pressures according to the adopted scale will be supplied to the sub-stations where it will be transformed and converted to direct current at a pressure of 1,500 volts; the locomotives will have two junctions or contacts (by the third rail and by overhead line); a pressure of 3,000 volts will be permitted on some lines as a matter of exception; and measures will be adopted to ensure that all electric locomotives will be able to utilise all French normal gauge lines.

Hydro-Electric Developments.

France's water power, which is estimated to amount to eight or nine million horse-power, will, it is expected, be utilised to the extent of over 3,000,000 h.p. by the end of next year.

The four great schemes for which the assistance of public authorities is considered as assured are those of the Rhône, the Dordogne, the Truvère, and the Rhine. The first, sanctioned by the law of May 27th, 1921, which has a three-fold aim, to obtain electric power, to render navigable the Rhône up to the Swiss frontier and to irrigate the land, is to be undertaken by the Compagnie Nationale du Rhône with a capital of 360,000,000 fr. The average power of the sixteen stations is planned at a total of 1,157,000, and the maximum at a total of 1,469,000 h.p.: the five principal stations will be Génissiat (average 206,000; maximum 240,000): Valence (117,000; 165,000); Montelimar (137,000; 174,000); Montdragon (188,500; 240,000); and Avignon (93,500; 127,000). Of the remaining eleven power stations Baix (between Valener and Montelimar) will have an average power of 70,500 and a maximum of 95,000, and for Glun (above Valence) these figures are 62,000 and 80,000 h.p. The cost of this scheme is put at 3¼ milliards of francs at 1921 prices.

One Dordogne scheme includes the construction of four power stations with a total maximum capacity of about 250,000 h.p. at a cost of 290,000,000 fr., and the second proposes the erection of three stations with an average capacity of 170,000 h.p. at the same cost. The Truvère (a tributary of the Lot) scheme, which provides for two power stations with 44,000 and 74,000 h.p. respectively, is estimated to cost 210 millions.

As regards the utilisation of the Rhine, a general plan for the stretch between Huningue and Strasbourg has been drawn up, whereby at each of the eight sluices power stations would be erected. Application has been made for the concessions for the first (at Kembs), which would furnish an average power of 50,000 kilowatts. The official calculation of the total average power to be provided by the Rhine Lateral Canal is 450,000 kilowatts.

Careful consideration, says Mr. Cahill, is being given to the question of distribution in order that efficient services may be maintained at all points within determined areas. Linking up, where desirable and possible, is also being arranged.

Great Transport Programme.

It may be said that France's programme of transport improvement is truly ambitious. It includes the construction of various lines which will facilitate communication with Alsace and the Sarre, and of others to improve connections with some of the Atlantic ports in order to attract traffic through to Switzerland and Central Europe. Much work has been done in the re-equipment of French ports generally and in a number of important extensions, whilst further large sums are to be expended. The work at Dunkirk will aid the transit of minerals exported from Lorraine; at Havre oil-handling facilities are a feature; Rouen now surpasses Marseilles in the quantities of goods loaded or discharged, chiefly on account of its being the chief French coal port. At Caen there are projects to facilitate the export of iron ore from the Normandy mines, whilst at Cherbourg, where three large British steamship companies have offices, an expenditure of over 15,000,000 fr. is contemplated.

Marseilles-Rhône Scheme.

The report also summarises the remarkable Marseilles-Rhône scheme, which comprises both an inland and a maritime section. The scheme appears to contain considerable possibilities of development and improvement for the whole Marseilles region.

Future of British Trade.

After referring to the way in which British trade with France has been hampered by the course of the exchange and high import duties, the Commercial Secretary finds matter for congratulation in the fact that British imports into France last year were 364,000,000 fr. higher in value than in 1921. They were surpassed only by those of the United States, which, however, diminished by 211,000,000 fr. in comparison with the previous year.

A closer examination of the situation does not, however, bring to light very good prospects for the future. The increase in value of British imports is mainly due to the large imports of coal. Wool, woollen waste and woollen goods together make a bad second, and in this branch the manufactured articles are likely to be less needed from Bradford as time goes on because of the advancing state of the French woollen industry. It is true that iron and steel, together with machinery and machine tools, showed a healthy total last year, but this is due to the large demand for the re-equipment of the devastated area which, before long, will come to an end. A heavy fall is recorded in the imports of steam and other engines which, at one time, constituted an important item in British trade with France. A no less heavy fall is recorded in imports of engines from the United States and Germany. The increased capacity of domestic manufacture is evidently the cause.

There are many national developments which are likely to diminish the demand for foreign coal within a few years. Output is steadily increasing, partly as the result of electrical equipment, whilst consumption is decreasing owing to the water-power development and railway electrification plans, which have already been described.

Mr. Cahill's interesting account of the reconstruction of the devastated regions may be summarised as follows:—

	1914.	Oct. 1st, 1923.
Population (in 1918, 2,075,700) ...	4,690,100	4,059,000
Elementary schools	7,298	7,008
Pupils	647,178	462,953
Teachers	14,205	13,725
Post Offices	1,259	1,313

Of 3,306,350 hectares (8,266,000 acres) which had been devastated 3,015,100 hectares (7,537,700 acres) had been cleared of projectiles, trench works and barbed wire, and of 1,923,500 hectares (4,809,000 acres) of devastated agricultural land 1,533,400 hectares (3,833,500 acres) had been brought under the plough. The main railway systems had been completely restored, and the reconstruction of the damaged light railways had made a great advance; 1,041 out of 1,157 kilometres of waterways had been made navigable again, and of 58,697 kilometres of roads 23,625 had been improved and 31,471 kilometres restored to traffic.

Test of Micanite Insulation.—To dispel any doubts existing in the minds of users or prospective users of its pillar units, as to the efficacy of the micanite insulation used in them, W. T. Henley's Telegraph Works Co., Ltd., recently gave samples of these units a severe testing.

The "Henley" units are built up on solid-drawn steel tubes of a special quality, the tubes being rendered permanently rustproof before insulation. The mica forming the insulation is applied directly to the steel tube, and gradually built up under great pressure while hot until the required thickness is attained. The tubes are next covered with a specially impregnated paper, rolled on under great pressure, and are then stoved at a high temperature, the tubes being finally treated, inside and out, with a coat of acid-resisting, non-hygroscopic material.

The original tests were carried out on units which had been immersed in water for a week, and the average breakdown pressure was found to be 23,000 V, which was identical with the "dry" breakdown voltage. The latest tests were made upon units which were placed in the Thames at Gravesend for a week. One was fixed to a jetty where it was alternately covered by the tide and exposed to the weather, and the other was placed in the mud. At the end of the week the units were washed and superficially dried and subjected to a series of puncture tests. The first breakdown occurred at the neutral fitting at 22,000 V. After running up the voltage again the second breakdown occurred at the positive fitting at just over 22,000 V. The third breakdown, at 23,000 V, happened at the negative fitting.

Encouragement for Contractors.—The following anecdote appeared in the April issue of *Contact*, the N.A.S.E. journal:—"There was an electrical contractor who started some twenty years ago. He worked hard early and late, personally supervised all work done, prepared and checked all estimates, and sat up into the early hours of the morning making up his accounts and planning extensions to his business. He has now retired with a comfortable fortune of £50,000. This money was acquired by industry, economy, conscientious effort to give full value, indomitable perseverance, and the death of an uncle who left him £49,999 10s. 6d."

THE LEA COAL METER.

A "Coal-Flow" Indicator.

THE desirability of providing suitable indicating and recording instruments in electricity stations to check the efficiency of the boiler and generating plant is generally recognised. Indicators of the rate of flow of water, steam, electricity; and the percentage of CO_2; of the intensity of draught, pressure, temperature, &c., are well known, but the determination and the rate at which the vital element (*viz.*, coal) is being consumed is a more difficult problem, although the importance of being able to observe instantaneously the rate of flow of coal into the boiler furnace, or its rate of combustion in lb. per hour, does not need much emphasis.

Mechanical stokers in general, however, and those of the chain-grate type in particular, in which the coal flows into the furnace continuously in the form of a stream, afford opportunities, not only of measuring the total amount of coal consumed in any period of time, but also of determining at any moment the rate at which it is being consumed. This is done with the aid of the Lea coal meter, a distinctly novel appliance at the present time that, nevertheless, is giving satisfaction to its users. The accompanying illustration, fig. 1, indicates the point where the measurement takes place, *i.e.*, the fire door, and the device may be used as a meter, fig. 3; meter combined with rate of flow indicator, fig. 4; or rate of flow indicators only can be supplied, fig. 2. The principles of operation are as follows:—

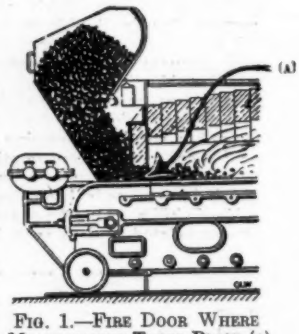


FIG. 1.—FIRE DOOR WHERE MEASUREMENT TAKES PLACE (A).

If a chain-grate stoker were to operate always at one fixed speed, the rate of flow of the coal would be directly proportional to the thickness of the fire, but such stokers are geared to enable them to function at several speeds in order to cope with varying demands for steam; the driving mechanism, however, runs at an approximately constant speed. These facts are made use of in the coal-flow indicator, the essential feature of which is the provision of a series of scales, as many as there are fixed speeds for the stoker, over which a pointer (operated from the fire door) is capable of moving, each scale being graduated in lb. or cu. ft. per hour in accordance with the speed at which the stoker is operating. The scales are mounted upon a drum within a dust-proof cast-iron case, and by means of the milled wheel seen at the left-hand side of fig. 2, the scale corresponding to the speed is brought to the front, the "rate of flow" being indicated by the pointer. The stroke of the instrument corresponds with the lift of the fire door and the steel cable connecting the latter with the instrument is kept taut by a spiral spring within the indicator casing; the scale drum may, if necessary, be operated automatically from the speed-changing gear, but simplicity is a feature of the device. The complete coal meter, fig. 4, is a combination of gear wheels and connecting dials, which run at a low speed, mounted in a dust-proof cast-iron case. The main drive is taken from the worm shaft driving the chain grate, and the position of the intermediate counting pinion is governed by the connection to the fire door shown. When the fire door is closed no units are required; when half open, half units are registered, and so on.

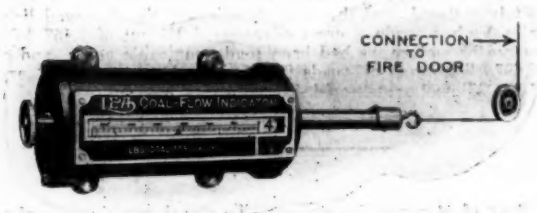


FIG. 2.—INDEPENDENT COAL-FLOW INDICATOR.

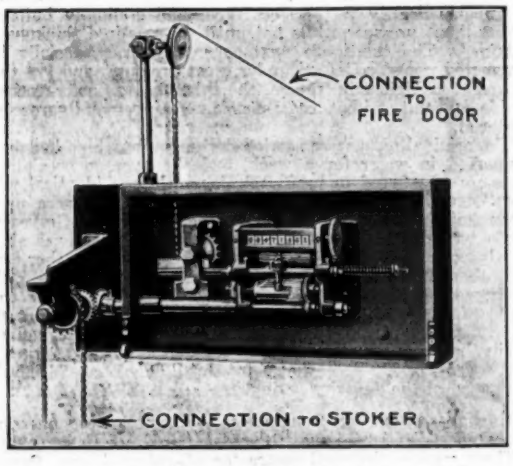


FIG. 3.—INTERIOR OF COAL METER.

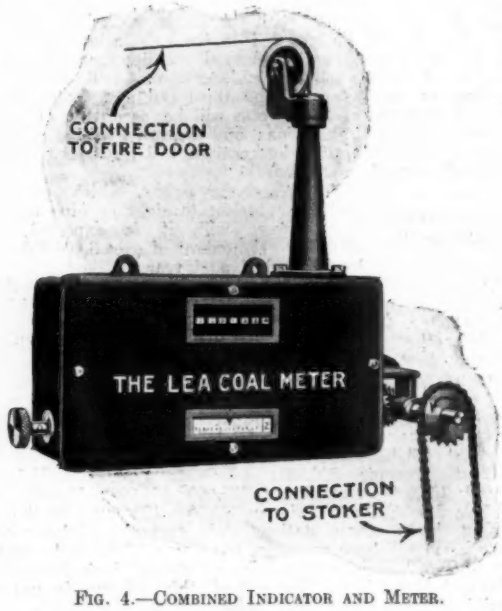


FIG. 4.—COMBINED INDICATOR AND METER.

It should be pointed out that the meter cannot weigh anything directly; it is solely a measurer of volume, but it eventually determines the net weight of coal consumed, and the Lea Recorder Co., Ltd., guarantees the accuracy of its coal meters and coal-flow indicators to be within 2.5 per cent., by volume. It may be argued, however, that the weight per cu. ft. of the various grades of coal used in a boiler house

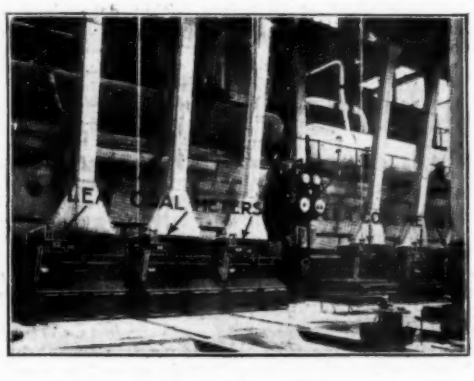


FIG. 5.—LEA COAL METERS AT KILMARNOCK.

varies greatly. The answer is that such variation is greatly exaggerated, and that in any case no variation is caused by the size of the particles of coal. It is strange but true that equal volumes of dry screened coal weigh the same, irrespective of the size of the particles, or whether they are in the form of nuts, peas, or slack. In many cases variation in weight is due to the presence of moisture in the coal, and seeing that a mass of coal in granular form occupies the same space, whether wet or dry, the Lea meter can be said to eliminate moisture errors.

Assuming, however, that the weight of dry coal does vary, the obvious thing to be done in such cases is a little systematic sampling, which may serve the double purpose of determining the average heat value and average dry weight of the fuel. In a large London electricity station wherein a large number of coal meters are being installed such sampling is being done, not once per shift, but once per hour.

The burning or bulging of the bottom edge of the fire door will, of course, effect the accuracy of the meter, but the meter constant can be easily corrected so as to allow for the small error thus introduced—the magnitude of which is shown by the fact that on examination what appeared to be a large bulge in a 6 ft. 6 in. fire door was found to be only 12 in. by about 0.5 in. deep, or about 3 sq. in., whereas the total area of the opening with an average 4-in. fire was $78 \times 4 = 312$ sq. in., so that the error was only one per cent.

Mr. W. C. Bexon, engineer and manager of the Kilmarnock Corporation electricity undertaking, has had two Lea coal meters working since 1918, each one on a boiler having two grates, and their readings compared very favourably each month with the amount of coal purchased. Since July, 1922, he has installed six more meters, fig. 5, one on each of the three grates of two 50,000-lb. boilers, and he finds that each meter on both boilers registers practically the same, provided the speed of each grate and the thickness of the fire is maintained the same. Tests showed that the meter figures were within 2 per cent. of the colliery weights, and even this can be allowed for when the class of fuel burned is taken into account, *viz.*, washed gum, which occasionally contains a large amount of moisture. Mr. Bexon states: "There are many advantages with these coal meters, one particular advantage being that the stoker can see at a glance (when the meter is fitted with a rate of flow indicator) the approximate rate of combustion at any moment, and it makes the stoker take a greater interest in his work when he can see exactly what he is doing."

Eight similar meters in a large works near London have given excellent results and tests with different classes of coal have led the electrical engineer to the conclusion that "the volumetric method of measuring coal is quite satisfactory, the error in no case being more than one per cent." He states that "the performance of the meters has been good in all respects, and they supply a long-felt want in the boiler house in a very simple way."

In the course of an article in the F.B.I. *Fuel Economy Review* in which Mr. M. Farrer, engineer and manager of the Twickenham & Teddington Electric Supply Co., Ltd., embodies the results of tests on Lea coal meters, he stresses the point that even if the meter were not as accurate an instrument as it undoubtedly is, its value would be but slightly diminished, as it is the comparative records obtained that are of value. It provides a means of checking with the greatest facility (and at practically no expense for supervision) the performance, not only of each individual boiler, but also of every stoker. In Mr. Farrer's station the meter records are logged at the end of each shift and a chart is prepared showing the record of each stoker on each of his shifts—thus yielding valuable results.

It was found, for example, that a certain stoker achieved far better results during the night shift than any of his mates. Another obtained poor results at night, but did very well during the heavy evening shift. Again, certain men who had for years been considered good stokers were found to be considerably behind their colleagues and were, therefore, given other occupations. Mr. Farrer proceeds: "As a result of the data thus all but automatically obtained, a spirit of emulation was set up in the men and improved results followed immediately. In order to foster this spirit, a bonus scheme was put into force by which the men obtain monetary reward for their improved efficiency. The results have been remarkable. Better coal figures are now obtained during the periods of lightest load than were previously obtained during the heavy load period. It can be stated without hesitation that the use of coal meters in a station where accurate methods of arriving at the coal consumption over any given period are not otherwise available, will result in savings which will pay off the original cost of the meters over and over again during the first year."

THE NORTH WALES COALFIELD.

An Electrification Proposal.

By W. G. PICKVANCE, M.I.E.E.

(*Abstract of paper read at a joint meeting of the* NORTH WALES COLLIERY MANAGERS' ASSOCIATION *and the North Wales branch of the* ASSOCIATION OF MINING ELECTRICAL ENGINEERS.)

THE application of electricity to coal-mining work has vastly improved the resources and facilities of the mining engineer. The plant installed by the Powell Duffryn Steam Coal Co. has no less a capacity than 52,000 kW, and its output last year equalled 115,000,000 kWh. Development to this extent would have been an impossibility if the efficiency of its application and the great economies that can be effected by its adoption had not been amply proved.

The necessity for the more economical winning of coal becomes daily of greater importance, and the only possible means to adopt with that end in view is a much more extensive use of electricity. This can best be done by co-operation, and it is my object to outline the means by which you can acquire "a cheap and abundant" supply, and a method whereby it will be readily available to every colliery in the Wrexham district.

It is doubtful whether electrical energy can be brought into this district from the water-sheds of North Wales at prices little less than double the figure at which you could produce it yourselves, but assuming it could be delivered at similar prices. you cannot ignore the logical sequence, which is that there will be less need for the commodity you are producing—coal.

Generation by each colliery at its own pit head would involve plant of, say, from 500 to 750-kW, with operating costs of from ¾d. to 1d., some might get so low as 0.6d. per kWh. This does not take into account the extra supervision needed or responsibility required of the management.

The smaller type of colliery usually needs from 500 to 100 h.p., unless it installs electric winders and fans, though I am of opinion that several collieries in this district could satisfactorily cope with all their requirements, including winding and driving of the fan, by the establishment of power plant varying from 500 to 1,000 h.p., some of them even less.

There are some 20 different collieries in Wrexham and district; about four of them have adopted electrical energy to a fair extent; about seven only have adopted electrical energy to a moderate extent; and about five only to a small extent; the rest have got simply a lighting installation, or no electricity supply at all.

If the waste heat at two or three of the main collieries was utilised by the adoption of mixed or exhaust-pressure turbines, a very great saving of coal would be effected in this district, and the price at which electrical energy could be supplied under such conditions would be very favourable indeed. If such collieries retained the use of their winding, fan, and compressor engines, the energy contained in the exhaust steam would be more than sufficient for all other power requirements at the collieries and, therefore, they would have energy to spare, which brings us to "Co-operative production for each other's benefit," an ideal method—the linking up of all the collieries with the addition of a central supply station as a base.

Those collieries that are not sufficiently large or are not so conveniently placed as to warrant the installation of exhaust-turbines should close their steam plant down entirely. They should wind electrically, their fans should be driven electrically, and, if they wish to retain the use of compressed air, their compressors should be electrically driven. If a co-operative scheme was adopted, the cost of operation at a colliery equipped throughout electrically would be enormously reduced, and the saving of coal throughout the N.W. coalfield would be tremendous.

Our problem in North Wales is a question of the steam turbine proposition as against the inefficient conditions generally prevailing. A properly designed and equipped central station in the middle of this area supplying all the collieries could easily, with the load factor obtainable, produce electrical energy at a not greater expenditure than 2.5-lb. of coal per kWh, assuming a calorific value of, say, 11,000 B.th.u.; assuming coal at, say, 10s. per ton, the cost for fuel per kWh produced would not exceed 0.13d. The consumption at the average old-fashioned colliery is considerably in excess of

50-lb. of steam per b.h.p. hour; in other words, 75 per cent. of the fuel at present burnt in collieries would be saved.

These observations would not be complete without some reference to coke ovens and by-product plant, but I do not know what the possibilities are in this district for the adoption of such works in conjunction with the suggested method of supplying electricity.

Many persons argue that it would be sound policy for the Wrexham coal industry to energise its collieries by means of power obtained from the proposed hydro-electrical installation of the North Wales Power Co. This idea is commercially impracticable; the cost of providing water storage and that of transmission over the long distance would be so high that the price per kWh would be necessarily high too.

On the North-East Coast under the Newcastle Combine, one station uses almost exclusively an inferior class of coal, for which there is little or no demand; the station has a capacity of about 14,000 kilowatts. I presume you have your share of "refuse coal."

Electrical winding is so efficient that no other scheme should really be considered; it would be very much cheaper than at present, and in some cases a motor could be applied to the existing gear.

An interesting winding equipment is that at the Harworth Main Colliery of Messrs. Barber Walker & Co., who, in addition to electric winding, have a complete power station of their own, designed mainly to cope with the winding proposition. The turbines supply the winding plant direct, and are assisted by flywheel accumulators. Special interest in the scheme lies in the fact that the shafts are 3,000 ft. deep, and their programme is 2,000 tons of coal per day, per shift from either shaft, the output per hour being 300 tons.

The new scheme consists of a combination as follows:—(1) Mixed-pressure turbines at collieries Nos. 1, 2, 3, 4. (2) A main station at the point where a sufficient quantity of water is available for condensing purposes. (3) A ring main, linking together all the collieries in the North-West section. (4) A trunk main, connecting, through the central power station, the collieries on the South side. The ring and trunk mains to convey 3-phase current at 11,000 volts. The overall length of the line would probably be some 12 or 14 miles, and one common pressure should be used throughout the system, so that the mixed-pressure turbines would work in parallel.

To save transformer costs the smaller collieries in the North-West section would probably be ringed together with a main at a lower pressure, which could be used direct on the bulk of the motors. The mixed-pressure turbines would be anything from 1,500 to 2,000 kW in capacity, and they would be so designed as to work fairly efficiently as high-pressure machines, while retaining the characteristics of, and efficiencies necessary for, an exhaust turbine. The idea behind this arrangement is influenced by the fact that in 3 or 4 of the larger collieries it is not likely that the steam winding, fan, and compressor engines will be replaced by electricity. Having this factor, therefore, to accept as a more or less permanent arrangement, we will take advantage of it by utilising those winding engines and their attendant exhaust turbines as stand-by sets for the main station, thus reducing the capital expenditure at the central point—a very important feature. The circumstances and conditions in this coal area may be characterised as peculiarly suitably for a very economical combination of mixed-pressure turbines in conjunction with a main station.

You would be able to cope quite satisfactorily and easily with all the power requirements at the collieries mentioned, including winding, with a total capacity of from 6,000 to 8,000 kW of mixed-pressure turbines. The diversity factor at these collieries would be sufficiently good to remove any apprehension as to the effect of heavy peak loads naturally attendant upon winding conditions.

The minimum size of unit for the main station would be in the nature of 5,000 kW. Probably two would be installed as a commencement, for it is more than likely that such a unit will be a useful size for dealing with the night load, consisting of pumping and ventilation throughout the whole coalfield.

Another factor which cannot be neglected is that once such a scheme is established, whether it is by a colliery combine or a limited company formed for the same purpose, the local authorities of this district, also the superior authorities, would have no alternative but to arrange for a general supply to the public from the same system. Your cost of production owing to the excellent load factor would be so low that electrical energy for general power purposes could be supplied so cheaply that the whole of the public demand would automatically fall into your lap, and if you will reflect upon the influence a scheme such as this would have upon the industrial development of the district, you will appreciate my reference to the community factor when considering the possibilities of bulk supply from the hydro-electric source on the other side of the North-Wales Electricity District.

Wrexham and district is an absolutely self-contained area as regards its possibilities industrially. It is a community comprising every factor for success industrially. You have mineral wealth in a compact area with sufficient population to provide labour, not merely for the mineral, but for any other industry which would establish itself. During the war, the female section of this community was trained to an appreciation of mechanical work, and developed such skill in connection with it that enterprising firms need have no fear whatever that every class of labour would be available for any industry they chose to establish.

But no industry will establish itself unless a cheap supply of electricity for power purposes is made available, and there is no reason whatever why the industrial area of North Wales should not be able to offer electrical energy as cheap as any other industrial district in the Kingdom. The present public price, however, of electrical energy for power purposes is absolutely prohibitive. Transport facilities are also all that could be desired.

To revert to our main subject, the cost of generating equipment at a maximum would be about £14 per kW; this includes all buildings and every auxiliary required. Assuming complete electrification of the collieries in the North-West section, omitting Llay Main and Gresford, and complete electrification of the other collieries referred to on the South-West Trunk Main, the total probable demand under normal trade conditions would be in the nature of 40,000,000 kWh per annum. Allowing for a load factor of 35 per cent. (and the conditions in normal times ought to approach 50 per cent.), the amount of plant required to deal with this load would not be greater than 16,000 kW.

Assuming, say, a capacity of 6,000 kW available from the mixed-pressure turbines, the size of the main station required would be 10,000 kW.

The total cost of the generating plant would, therefore, be: mixed-pressure turbines, say, £60,000; main high-pressure station 10,000 kW at £14, £140,000; mains, transformers, switchgear, contingencies, &c., £26,000. Total for whole scheme, £226,000.

The foregoing is simply a rough estimate, but it is sufficiently close for the object of this paper.

The capital charges on the above sum at 10 per cent. per annum would amount to £22,600, which has to be met by the income from electricity sold. After allowing for all working expenses, and considering the charges that are made to collieries by certain public supply companies in colliery districts, the absolute maximum you are likely to charge on an average to all your consumers is not more than 0.6d. per kWh, and some of the collieries would average less than ½d. per kWh; therefore, the revenue at 0.6d. per kWh equals £100,000. Your costs for that production should not equal more than one farthing per kWh, or £42,000 total. This leaves a gross return of £58,000. Capital expenditure absorbing £22,000 per annum leaves £35,400. Allow, say, 6 per cent. for depreciation (£13,560) and you have a net return on the whole scheme of £21,840.

These figures are open to modification, but the area is so compact, the demand such an excellent one, that the undertaking is bound to be a success financially if you will co-operate or form a company to put it into effect.

The electrification of your collieries would save 75 per cent. of the fuel you are burning, at least 8 per cent. of the total you are raising. For the year ended December 31st, 1922, you raised 2,743,755 tons; 8 per cent. of that amount equals 219,496 tons. Last year was not a good year as regards output, so we will assume, say, 3,000,000 tons raised, therefore 240,000 tons burnt; 75 per cent. of that amount saved equals 180,000 tons, at an average price of 8s. per ton means a saving to the colliery owners of £72,000 per year.

The capital needed for electrification could be provided out of the £72,000 saved per annum. You can complete the whole job throughout the area for considerably less than £720,000. As regards the whole of the country, the amount of coal used varies from 4 to 15 per cent. of the output, and I am satisfied that complete electrification will beat the former figure.

Finally, do not forget the possibilities of your central station acting as the supply base for East Denbighshire and the surrounding area generally.

A discussion followed the reading of the paper, and it was decided to convene a further conference of representatives of the North Wales Colliery Managers' Association and the North Wales branch of the Association of Mining Electrical Engineers, in order to discuss the practicability of the scheme.

The National Association of Supervising Electricians.—The April number of *Contact*, the Association's journal, contains the following statement: "Many people were surprised to note an advertisement in a recent issue of our contemporary, the ELECTRICAL REVIEW, asking for applications to fill vacancies as supervisors and foremen, which emanated from the National Association of Supervising Electricians. The necessity for such an advertisement was, we feel, not fully realised by all, but it was a fact that the announcement was the result of two important factors, of which the Association may well be proud, namely: (1) that certain employers had sufficient faith in the general efficiency of members of the N.A.S.E.; and (2) that the Association had no member unemployed among its ranks."

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Annual Report.

The Council at the 51st annual general meeting of the Institution yesterday presented its report for the year 1922-23 and, in so doing, recorded the continued progress of the Institution. It is noticed with satisfaction that the practice of stipulating corporate membership of the Institution as a qualification for appointments has been adopted by some employers and the Council urges its adoption by all. The membership is now 10,911, an increase of 636 on the previous 12 months; while the decrease during the war period was 471, the increase since has amounted to 4,298; 48 members died during the year.

The transfer to the Chartered Institution of the property of the old Institution has proved to be a more protracted process than had been anticipated, chiefly owing to certain provisions in some of the trust deeds; the final winding-up must necessarily, therefore, be postponed a short time longer. During the year a total of 369 meetings were held, 17 addresses and 8 lectures were delivered, and 20 papers were read; a number of papers were also published in the *Journal* without being read. The discussions have been consistently maintained at a high level and have been more spontaneous than in the past. It is pointed out that the fact that the same paper is read at several Centres and Sub-Centres appears to react unfavourably on the attendance at any particular meeting, and this may need consideration in the future.

During the session the president visited seven Centres and four Sub-Centres. The Council has decided to supply books to the value of £50 to any Centre wishing to establish a technical library (the books remaining the property of the Institution) provided the collection is added to locally.

The informal meetings have maintained their interest, although the average attendance was below that of last year. The number of Students on the register of the Institution has reached a record total of 2,869, representing 26 per cent. of the total membership, and a very full programme was carried out by the eight Students' Sections now in existence. Three scholarships have been awarded by the Council in addition to a grant from the War Thanksgiving Education Research Fund (No. 1).

The Council has arranged for a complete set of enlarged photographs of the past presidents to be hung in the Institution's rooms. During the year 235 books and pamphlets were presented to the reference library and a marked increase in attendance was recorded, the total number for the year being 2,526, of whom 125 were non-members. A continued increase in the circulation of books from the lending library is also recorded, 2,213 books being issued to 814 borrowers during the year. In view of the limited space available at the Institution for the exhibition of historical apparatus, &c., the Council has loaned the greater part of the collection in its museum to the Science Museum, South Kensington, where the exhibits will receive wider publicity.

The number of applications for posts received by the Electrical Appointments Board was 130, as compared with 120 last year. The net cost of printing and publishing the *Journal*, after allowing for sales, was £4,604 in 1922, compared with £4,936 in 1921; the practice obtaining in 1913 of publishing advertisements in the *Journal* has been reverted to. The Institution's contribution towards the publication of *Science Abstracts* was £1,085 in 1922, compared with £978 in 1921.

It has not been possible to complete the revision of the Wiring Rules during the session under review; it is hoped that the Model Conditions of Contract will be published shortly. Some progress has been made with the preparation of a scheme for the establishment of a British Electrical Proving House, and a scheme to give effect to the voluntary registration of electrical contractors has been approved by the Council, which has also appointed a Committee on Electricity in Agriculture.

The Regulations Sub-Committee of the Power Lines Committee has been given the status of a committee under the name of the Electricity (Supply) Regulations Committee, and as a consequence the original Power Lines Committee, together with its two sub-committees (wayleaves and factors of safety), has been dissolved. A set of draft regulations for low and medium pressure overhead lines was, together with a set of draft regulations for high-pressure lines, submitted to the Electricity Commissioners for their approval. The Committee is now considering amendments to the Board of Trade Regulations to enable the Council to submit a report thereon to the Electricity Commissioners.

The Committee of the Irish Centre has appointed, on behalf of the Irish Free State Government, a committee to advise, if requested, the Irish Government on matters concerning electrical engineering.

The scheme for the issue of certificates and diplomas to students who are trained and pass certain examinations under conditions approved by the Board of Education and the Institution, which was approved by the Council last session, has since been approved by the Board. The Joint Committee of representatives of the Board of Education and the Institution provided for under the scheme has been set up and certain courses of training and examination syllabuses and schools have been approved. It is expected that the scheme will come into operation for the educational session of 1923-24.

An Engineering Joint Council has been set up, the constitution of which is still under consideration. The Electrical Research Association has made good progress on all the researches in hand. The Institution has increased its annual subscription from £200 to £300, a corresponding grant being obtained from the Department of Scientific and Industrial Research.

Progress in connection with the standardisation of electrical materials and apparatus has been steady during the past year and eight British Standard Specifications have been issued. Progress has also been made in the preparation of the list of terms and definitions for use in electrical engineering.

The Committee of Management of the Benevolent Fund of the Institution reported that on December 31st, 1922, the capital account of the fund stood at £9,969, and the accumulated income at £1,463. The donations and subscriptions to the fund in 1922 amounted to £2,399. In the course of the year 40 grants were made to 16 persons, amounting to a total of £776.

The annual accounts of the Institution for the year 1922 show that after making provision for contingencies there is a margin to the good on the revenue account for 1922 of £862, which has been carried to the credit of the general fund, and compares with £639 in 1921, an increase of £222. The revenue amounted to £35,659 and the expenditure to £29,593.

The standing committees of the Institution now number 16, the sectional committees 5, and the special committees 8; in addition to the Wireless and Informal Meetings Sections of the Institution there are now 8 local Centres, 4 Sub-Centres, and 8 Students' Sections. The number of bodies on which the Institution is represented is 43.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Prospects for Electrical Engineers in Canada.

Since the appearance of the above article in the Electrical Review on April 13th I have had numerous letters from readers requesting further advice. These letters may be divided into three classes:—

1. Men who desire to obtain a position *before* leaving England.
2. Men who need assurance of securing a position immediately upon arrival.
3. Men who enclose testimonials with a request to be placed in touch with suitable vacancies.

I regret that I cannot hold out any hope to any of these types of inquiry, and would answer each class as follows:—

1. It is quite impossible to secure a position in Canada, whilst residing in England (unless sent out by an English firm to its Canadian branch).

2. Immediate positions upon arrival cannot be guaranteed. Some find positions within 60 minutes, others take about six months. A friend of mine arrived 18 months ago, was unemployed two weeks, took a job at $25 per week, and three months later was engaged at $4,000 per annum. He had special qualifications, but he took a chance, feeling he couldn't be worse off than in England.

3. This class entirely fails to grasp the spirit of the country. The presenting of testimonials on behalf of an applicant (by a third party) would be equally ineffectual. A personal interview is imperative. In an ordinary business way we think nothing of making a trip of a thousand miles, merely to obtain the benefit of the personal touch. Whatever splendid testimonials the applicant may possess, he stands little chance against the "man on the spot." Furthermore, the applicant would need to be a regular "wizard" in engineering before a busy executive would be likely to suffer any inconvenience for a period of eight weeks before he could even *see* upon what he was investing his dollars.

It is the boast of the country that we "act quick"; therefore the leisurely method of engaging in a prolonged correspondence with an applicant at the other end of the world is not likely to appeal to the imagination of an employer.

In passing, I might add that there is an acute labour shortage in the U.S.A., but no more English can be admitted before August, as the quota from that country is complete for the current year. Canadians are not subject to such restrictions. (A hint to the wise will suffice.)

The object of my article was to create a word picture of the conditions in Canada, and the possibility of suitable persons to fit themselves into the picture.

I have already written to several of the gentlemen who have honoured me with their confidences, but I realise that the task of replying personally to each inquiry would absorb more of my time than I can afford to devote to this correspondence. Therefore this letter must suffice as my general advice on this subject.

Geo. R. Archdeacon.

Toronto, *May 10th*, 1923.

Small Power Stations.

In your issue of May 11th you publish an article by Mr. Hawkins under the heading of "The Financial Aspect of Small Power Stations." No one appears to have written criticising this article, and I do not think such an article should be allowed to pass without serious correction, or it might be presumed that the estimates and deductions were not controvertible. Anyone who has made a special study of the capital costs, and more important still, the working costs, of electricity supply for small townships, will have much to say.

From the estimates I judge that the town under review has a population in the neighbourhood of 14,000, and the capital proposed is not far out in the aggregate, but the various items are in some cases very wide of the mark. For instance, land £500 is, I should say, an absurd figure somewhere in the neighbourhood of 2 to 2½ acres. Buildings again, unless offices are supposed to be included, is extravagant. The battery mentioned is very much too small for economical working conditions.

To work a supply in a small town economically depends entirely on the load factor of the *plant working*, and not nearly so much upon the load factor of the station. With ample battery plant it is possible to so arrange the running of the plant that it is always working at maximum load factor. It is the mistake made by nearly all the small towns by having too small a battery that is the principal cause of high cost.

The estimated annual expenditure again lends itself to much criticism. Evidently the intention is to run machinery for 21 hours per day, judging from the chart; for such a small station this would be the very worst engineering advice possible. Labour must be kept down. With an output such as that specified my estimate of working costs, if the plant was laid down to my specification, would be on the following lines, and I should be prepared to guarantee the result:—

Directors	£200	Repairs	200
Engineer and manager...	400		
Lineman and mate ...	300		£3,250
Power-house engine engine driver and cleaner	300	Overhead Charges. Clerical Assistance ...	£250
Watchman	150	Insurance: Rates and taxes, stationery, &c....	600
Oil fuel, at £4 10s. per ton	1,500		
Oil stores	200		£4,100

showing a reduction in working costs of £1,830, or a gross profit of £4,292, as against £2,462 stated.

For a town of the size I have assumed, which is indicated by the capital proposed, the output of 394,200 units sold would amount to no less a figure than 28.1 per head of population, which again seems to confirm the assumption I have made as to the size of the town.

J. E. Stewart, M.Inst.C.E., M.I.E.E.

Llanelly, *May 25th*, 1923.

Trading Organisation.

I read with great interest the letter from Mr. W. F. Higgs under the above heading in your issue of the 18th instant.

The points raised in this letter are of vital importance to those who are anxious to bring about an improvement in the relations between the various selling organisations of the electrical industry. The questions raised will have to be answered before any real progress can be made, and for this reason we should welcome the other man's point of view. I agree that *healthy* competition is the making of industry, and so far as I understand this movement, there is no desire to interfere in this direction or to form anything in the nature of a combine.

I believe the sole objects for suggesting joint organisation are to establish uniform and reasonable discounts, to ensure electrical goods being supplied through legitimate trade channels, to prevent unnecessary overlapping, thereby reducing cost of distribution and ultimately securing reduction in prices to the consumer, preference to be given to British manufacturers where possible but with no idea of increasing prices to the consumer.

The analogy drawn by your correspondent between accessories and motors is rather interesting. I feel sure his conclusion "that there is not one wholesaler in this country to-day that could give a stock order for twenty 10-h.p. motors at a time" is wrong. In fact, I know plenty of wholesalers and even some contractors who could place orders of this size, provided always that suitable terms were offered and they had the security that the manufacturers would not endeavour at every opportunity to short-circuit them by taking orders direct from the user without even covering the contractor for a reasonable margin of profit. It is because of this insecurity that many wholesalers and contractors are being driven to sell Continental motors which are coming in increasing quantities from abroad, the prices of which enable these middle-men to compete with British manufacturers and secure orders at a reasonable profit which they otherwise would not get. Many of these middle-men would never have entertained foreign motors if the British manufacturers had treated them rightly.

In recent Press articles and letters there has been a tendency to look upon the wholesaler as an unnecessary part of the sales machinery, and it is time that those people who make these rash statements were corrected.

The wholesaler would not be in existence to-day if he were not necessary. He has played his part in the past, and will continue to do so in the future in spite of all that may be said to the contrary. Like the poor and the plumber, the wholesaler will always be with us—that is, the genuine wholesaler who carries reasonable stocks.

Like the contractor, the wholesaler is often saddled with the faults of those who are not qualified to use the title, and this is where we get back to the question of organisation. The type of wholesaler about which we all complain would not have been in existence if certain manufacturers had refused to give them suitable terms until they could conform to the requirements of a genuine wholesaler. The same applies to contractors who are obtaining factors' terms from some manufacturers and who pose as semi-wholesalers to the detriment of genuine wholesalers and their fellow contractors.

It is with the object of rectifying all these faults and meeting all these complaints that certain members of the electrical industry are endeavouring by some kind of organisation to deal with them; hence the publication of the E.C.A. manifesto.

Hull, *May 22nd*, 1923. **T. Beadle.**

Low-Temperature Heating.

Your article on low-temperature heating was particularly interesting to myself, as I have been experimenting with this method of heating for over two years, but not on the same lines as Mr. Grierson. My experiment has been with the same methods as those adopted in the case of steam and hot water, and my invention has been the combination of a suitable electric heating element with iron piping. The pipes are run round the skirting-boards of rooms, each length of piping having its own switch, so that a room may be heated from three or four points, causing a complete distribution of heat over the whole room.

The results have been extraordinary, as I have proved that with 0.6 watt per cu. ft. I can give a minimum of 60 degrees of temperature over the whole room; also like Mr. Grierson I can warm any section of a room by means of tubular radiators which I fit in recesses, bay windows, &c., or by portable radiators of the same type. I have proved that with this method of low-temperature heating the whole of the room is well heated as stated to 60 degrees and over, and that the saving is approximately 60 per cent. over the consumption of electric fires or radiators. I have also tested the element to different heating degrees on the outside of the piping, and have reached as high as 650 degrees, which has been required for special purposes.

The low-temperature heating in my tubular system is usually supplied at 150 degrees on the outside of the pipe, which is the correct heat to dissipate in the room to the best effect, but I can arrange this system to give at any moment the heat required at any portion of a room.

My leaflets will show the principle adopted, and I shall be pleased to explain the system to anybody interested.

John Lightfoot.

Manchester, *May 23rd*, 1923.

Electrical Prospects in America.

Would you please inform me, through your paper, in what condition the electrical trade is in America at the present time, and whether there is likely to be plenty of work for some considerable time or not.

Old Reader.

May 27th, 1923.

[A similar inquiry has been received from "Ex-Service." The matter is referred to in Mr. Archdeacon's letter on Canadian prospects on p. 877. Possibly some of our readers will kindly help our correspondents.—EDS. ELEC. REV.]

Electricity in Iron and Steel Works.

I notice an article in your issue of the 11th inst. headed "Electricity in Iron and Steel Works," by Mr. C. A. Ablett, M.Inst.C.E., and in the second paragraph it is stated that a kWh can be produced for 0.2d. at a load factor of 65 per cent. No information as to the cost of fuel is given. He then goes on to state that at another load factor, 21.5 per cent., the cost would be 0.57d. per kWh for fuel, and compares this with a coal-fired boiler giving 0.42d. and 0.86d. respectively. Such statements are very misleading, and of doubtful honesty, no cost of fuel being given, or measure of fuel consumed. Taking coal at present prices, and taking the consumption met with in actual commercial power company practice as being attainable at a steel works, the cost of fuel would be as follows: 2.2 lb. fuel at 18s. per ton, equals say 0.2354d. as against .42d., and so on. The author evidently overlooks the fact that the economy to be obtained in a works from running any machinery depends on the load factor of the *running machine* and not the load factor of the whole works. Many mistakes have been made in works on account of not bringing in a specialist to advise. It is a very serious matter, but because the whole power cost in most works is such a small percentage of the total costs it is difficult to move the "powers that be," possibly principally because they do not want to tread on someone else's toes by employing someone outside the works to advise.

In one case I offered to save a minimum of £1,000 in a year with no fee and without necessitating alteration or addition to plant, and I wanted 10 per cent. of all I could save above that figure, but nothing came of it; why? Engineers trained in modern electric power operating could do what I offered to do.

But to get back to the article under discussion, the author fills it up with arbitrary statements of costs, most of which are controvertible. Such a paper is a danger, and in my opinion not an assistance, to engineers or the industry.

J. E. Stewart, M.Inst.C.E., M.I.E.E.

Llanelly, *May 26th*, 1923.

Small Village Lighting Schemes.

The writer noticed in your issue of May 25th, Messrs Johnson & Phillips's advertisement for cables on page 8, in which they mention "A Village Electricity Scheme," claimed to be the first of its kind North of the Tyne. With all due respect to Messrs. Reid, Ferens & Co., and in justice to the Newcastleton Electric Supply Co., the writer begs to contradict the statement, and in the hope of developing this useful industry he will give details of the scheme, which is claimed to be the "first," and also the most unique.

In September, 1921, a few tradesmen of the village—of 850 inhabitants—were approached by the writer *re* such a scheme. In February, 1922, the work was entrusted to him, and with a capital of £1,000 the whole job was carried through. In May, 1922, the company was registered as a private limited company, and in the same month an inaugural dinner was given to which an invitation was extended to business men of near-by villages, amongst whom were the gentlemen who are now directors of the Wark Electric Lighting Co.; they were so impressed by the job that they asked the writer to address a public meeting, which, together with Messrs. Edison and Swan's Newcastle superintendent, he did. At Newcastleton a small galvanised iron building contains two 4.5-kW sets, with a 100-Ah battery panel, battery charging panel, and distributing panel with change-over switches, enabling the operator to switch either set on to either circuit of the overhead mains or on to the battery charging circuit. There is also a Board of Trade panel, containing automatic circuit breakers, earth leakage indicator, and watt-hour meters. The generating sets are Aster-Ediswan sets running on paraffin, and these sets—although they are single-cylinder engines—are run direct on the mains with every success and without flicker. The writer cannot speak too highly of the combination of engine and dynamo, which is, of course, compound wound.

The company has erected 30 poles and lighted the village streets with 21 60-watt gasfilled lamps, all within the limits of its capital. The first year is now completed and has shown a great success. All material is by the Edison Swan Co., and all wiring was done on the Edison-Swan wiring system. The price charged per kWh is 1s. As the plant is now fully loaded the company will have to contemplate an extension of plant.

The writer has made a study of this class of work for many years, and is now confident that such schemes in small towns and villages will not only add to the comfort and convenience of the inhabitants, but can be made to pay those financially concerned.

The whole secret rests in the fact that no capital is sunk which is not earning revenue—in other words, a plain, cheap, and good job without any elaborate layout.

Wishing success to all such undertakings.

C. Wood,

Engineer, Newcastleton Electric Supply Co., Ltd.

Newcastleton, *May 26th*, 1923.

A Broadcasting Problem.

In your issue of May 18th, 1923, under the designation of "A Broadcasting Problem," several theories are put forward in explanation of the overhearing on a near-by three-valve set of a remark made by a lady wearing the head receivers on a crystal listening-in set. To telephone engineers this effect is known as induction, and in the early days of telephony gave considerable difficulty, as conversations on one circuit could be heard on adjacent but entirely separate circuits. These effects have still to be guarded against by special methods of construction and circuit arrangements, which now are standardised.

In the case in point, when the diaphragm vibrates in response to the voice or other sounds minute currents circulate in the crystal detector circuit, which includes the inductance coil attached to the aerial, and so produce very weak inductive effects on the adjacent aerial of the three-valve set, where they are amplified and reproduced sufficiently loud to be heard.

There are many listeners-in who hear strange faint voices occasionally. These usually have aerials in the neighbourhood of telephone overhead routes, and the cause is similar to that already explained.

Joseph P. Price.

Croydon, *May 26th*, 1923.

LEGAL.

Bodmin Electric Light Company Fined.

ACCORDING to a Truro newspaper the Bodmin Electric Light Co. has been fined 5s. on four summonses for employing two lads under 18 years of age after 8 p.m. and for employing the same lads on Sundays.—Mr. W. E. Harding, H.M. Inspector of Factories, Plymouth, mentioned that the charge was not of employing illegally, but of being the owners of the premises on which young persons were employed illegally.—Mr. M. F. Edyvean, defending, said the company had instructions that young persons could work until 10 p.m. in electric light works if a form was sent to the inspector of factories.—Mr. Harding replied that the form was not sent. The form applied only to persons between 16 and 18, and it could not have applied to the younger boy.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

12,806. "Electric transmission of power." A. M. Taylor. May 14th.
12,809. "Thermo telephone receiver." E. D. Young. May 14th.
12,814. "Voltaic cells and batteries." A. F. S. Rowe. May 14th.
12,830. "Wireless receiving apparatus." A. Connolly, J. Connolly, and W. Connolly. May 14th.
12,834. "Electric heating devices for singeing hair, &c." J. W. Barnard and T. C. Dawkins. May 14th.
12,847. "Tuning wireless receiving circuits." H. F. A. Sanderson. May 14th.
12,849. "Telephonographs, &c." A. F. R. Cotton. May 14th.
12,859. "Resistance control devices." H. J. Wiegand. May 14th. (United States, May 15th, 1922.)
12,862. "Rectifying apparatus for alternating electric currents." Hewittic Electric Co., Ltd. May 14th. (France, May 15th, 1922.)
12,872. "Dynamo-electric machines." W. H. Dean. May 14th.
12,884. "Electric resistances." H. B. Clapp. May 14th.
12,885. "Submarine sound receivers." C. P. Ryan. May 14th.
12,894. "Electrically-operated motor-cycle." Bullo-Fahrzeugbau Ges. May 14th. (Germany, May 12th, 1922.)
12,895. "Closed receptacles." British Thomson-Houston Co., Ltd. (General Electric Co.). May 14th.
12,910. "Radio-telegraphic aerial supports." H. Caen. May 15th.
12,911. "Radio-telephonic inductances." H. Caen. May 15th.
12,913. "Telegraphic transmission of pictures." E. E. Fournier d'Albe. May 15th.
12,921. "Contact breakers for engine ignition systems." H. B. Stocks and H. R. Stocks. May 15th.
12,957. "Locking electric lamps in holders, &c." J. A. Orme. May 15th.
12,960. "Wireless detector." R. Blakoe and H. A. H. Duncan. May 15th.
12,984. "Method of opening electric incandescent lamps." General Electric Co., Ltd. May 15th. (United States, June 1st, 1922.)
12,994. "Frequency multiplying transformers." W. Dornig. May 15th. (Germany, August 9th, 1922.)
12,995. "Circuit arrangements for frequency-multiplying transformers." W. Dornig. May 15th. (Germany, November 29th, 1922.)
12,997. "Electrical apparatus." W. A. Appleton and J. Joseph. May 15th.
13,006. "Undercutting electric insulation in commutators of dynamos, &c." J. W. Gee and W. F. Higgs. May 15th.
13,032. "Wireless receiving apparatus." A. J. Barnett and S. Jonas. May 15th.
13,034. "Thermionic valve devices." G. C. Beddington. May 15th.
13,037. "Electric resistance units." Ward Leonard Electric Co. May 15th. (United States, August 24th, 1922.)
13,042. "Mountings for electric lamps." R. E. Lambert and Lamberts, Ltd. May 15th.
13,061. "Crystal detectors for wireless telegraphy, &c." H. Hardware and F. Winstone. May 16th.
13,072. "Sparking plugs." T. Brown. May 16th.
13,084. "Sound-reproducing apparatus." A. R. Kahl and Sir W. Noble. May 16th.
13,085. "Electric relay for telephone systems." J. E. Collyer and Coventry Automatic Telephones, Ltd. May 16th.
13,101. "Device for preventing oiling-up of sparking plugs." M. Drysdale. May 16th.
13,106. "Contacts for wireless crystal sets." D. R. Cochrane. May 16th.
13,113. "Electric measuring instrument." W. B. Good. May 16th.
13,116. "Accumulator grids or plates." J. M. Burnett and W. Haddon. May 16th.
13,117. "Unit for accumulator plates." J. M. Burnett and W. Haddon. May 16th.
13,118. "Accumulator plates." J. M. Burnett, J. A. Fullilove, and W. Haddon. May 16th.
13,119. "Accumulators." J. M. Burnett and W. Haddon. May 16th.
13,128. "Electric terminals, &c." H. J. Betts. May 16th.
13,131. "Receiving apparatus for wireless signalling." R. H. Barbour and Electrical Apparatus Co., Ltd. May 16th.
13,133. "Means for producing variable electric frequencies." A. F. R. Cotton. May 16th.
13,135. "Electric ovens." C. R. Belling. May 16th.
13,136. "Electric heaters." C. R. Belling. May 16th.
13,140. "Method of charging electric storage batteries." E. Pöhler. May 16th.
13,142. "Variable condensers." G. Seibt (firm of). May 16th. (Germany, May 30th, 1922.)
13,145. "Telephone systems." C. Berner and A. Clifford. May 16th.
13,151. "Intervalve transformer systems for use with thermionic valves." E. A. Graham and W. J. Rickets. May 16th.
13,155. "Electromagnetic clutch and variable-speed gear." A. J. Fippard. May 16th.

13,157. "Transformers for telephony and wireless signalling." M. Cooper, H. T. C. Electrical Co., C. F. Hurst, and A. H. Triggs. May 16th.

13,163. "Electric switches, &c." British Thomson-Houston Co., Ltd., and A. S. FitzGerald. May 16th.

13,164. "Electric heaters." British Thomson-Houston Co., Ltd. (International General Electric Co.). May 16th.

13,168. "Control of petrol supply and magneto of motor-cycles, &c." A. J. Marshall. May 16th.

13,178. "Automatic brakes, clutches, and starting devices for electric motors." H. E. Dance. May 17th.

13,179. "Insulation for storage batteries." Svenska Ackumulator Aktiebolaget Jungner. May 17th. (Sweden, December 12th, 1922.)

13,180. "Crystal detectors for wireless telegraphy, &c." Winfield Bros., Ltd., and C. J. C. Winfield. May 17th.

13,196. "Receiving apparatus for wireless telegraphy, &c." G. E. Dockree. May 17th.

13,206. "Alternating current electro-magnets." P. F. Harris and A. Reyrolle & Co., Ltd. May 17th.

13,211. "Alternating-current motors for coal-cutting machines, &c." W. A. Logan. May 17th.

13,213. "Telephone receivers, &c." W. K. Barker, F. A. Jones, and S. G. Jones. May 17th.

13,218. "Wireless tuning device." W. G. Aston. May 17th.

13,233. "Thermionic valve holders." A. K. E. Strathdee. May 17th.

13,248. "Thermionic valves, &c." W. H. Derriman and J. Robinson. May 17th.

13,250. "Amplifying valves." A. Garbarini. May 17th.

13,252. "Means for protecting electric-current networks." J. E. Pollak (Hengelosche Electrische en Mechanische Apparaten Fabriek). May 17th.

13,253. "Electromagnetic separation or concentration of minerals." W. M. Mordey. May 17th.

13,255. "Electric motors." Eastern Telegraph Co., Ltd., and H. V. Higgitt. May 17th.

13,260. "Electric switches, relays, &c." British Thomson-Houston Co., Ltd., and A. S. FitzGerald. May 17th.

13,263. "Telesitemeter listening apparatus." A. J. Marcelin. May 17th. (France, July 19th, 1922.)

13,265. "Means for controlling vacuum in X-ray tubes." W. E. Schall. May 17th.

13,271. "Portable electric lamps." L. Rosengart. May 17th. (France, May 18th, 1922.)

13,300. "Controlling, &c., electric lights." W. T. Jones. May 18th.

13,322. "Wire-drawing machines." Western Electric Co., Ltd. (Western Electric Co., Inc.). May 18th.

13,328. "Signalling apparatus." W. J. Polyblank. May 18th.

13,334. "Devices for displaying and vending wireless crystals." C. J. Coleman. May 18th.

13,335. "Electric ceiling lamps for motor-cars." M. Dacomo. May 18th.

13,337. "Telephone receivers." J. A. Fleming. May 18th.

13,338. "Control of trains, &c." A. R. Angus. May 18th.

13,344. "Regenerating electric cell." W. Amor, H. K. Foster, and W. G. Moores. May 18th.

13,352. "Laying tramway, &c., tracks." J. Harvey and R. H. Rippon. May 18th.

13,356. "Means for connecting telephone, &c., terminals." V. C. H. Gibson. May 18th.

13,362. "Variable coupler for radio-telegraphy, &c." G. E. Dockree, H. C. Highfield, and Hogarth Engineering Co. May 18th.

13,366. "Starting devices for electric motors." J. L. P. Macnair. May 18th.

13,380. "Wireless receiving sets." L. D. Hill and G. M. Wright. May 18th.

13,382. "Wireless telephone receivers." Soc. Française Radio-Electrique. May 18th. (France, May 18th, 1922.)

13,383. "Vibratory diaphragms." Soc. Française Radio-Electrique. May 18th. (France, May 20th, 1922.)

13,394. "Detectors for radio-telegraphic, &c., apparatus." A. B. Elsbury. May 18th.

13,398. "Electric plug and socket couplings." T. L. R. Cooper. May 18th.

13,401. "Electric primary cells." L. Darimont. May 18th.

13,403. "Electric switches." E. Dobson. May 18th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

29,003. "Devices for cooling dynamo-electric machinery." H. Stevens and Premier Cooler and Engineering Co., Ltd. November 1st, 1921. (196,946.)

1922.

146. "Electric switches." W. W. Burnham. August 15th, 1922. (196,968.

207. "Means for effecting phase adjustment of electrical systems." F. E. Pernot and L. J. Rich. January 4th, 1922. (196,971.)

427. "Manufacture of electric insulating sheets or layers." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. August 8th, 1921. (184,436.)

2,267. "Electric lighters." A. Wirth. January 26th, 1921. (174,613.)

2,513. "Synchronous telegraphic systems." Western Union Telegraph Co. and J. V. Foll. January 27th, 1922. (196,980.)

2,676. "Windings of electrical coils." C. B. Kersting and U. Beaton. January 30th, 1922. (196,986.)

2,738. "Automatic electric switching systems." H. Baron (F. Aldendorff). January 30th, 1922. (196,990.)

3,081. "Electricity supply systems." Siemens Bros. & Co., Ltd., and H. G. Wood. February 2nd, 1922. (197,001.)

3,126. "Electrical and mechanical connections or joints." British Electric Transformer Co., Ltd., and S. C. Mount. February 2nd, 1922. (197,006.)

3,228. "Voltaic cells." A. de G. Spino. February 3rd, 1922. (197,013.)

3,240. "Means for preserving an electric motor against the action of an injurious surrounding-medium whilst ensuring lubrication and cooling of the motor." R. Longue. February 3rd, 1922. (Addition to 159,862.) (197,014.)

3,270. "Rectifying and connecting and disconnecting switches for alternating electric currents." H. G. H. De J. d'Avenas. February 15th, 1921. (175,615.)

3,522. "Signal systems for telephones." T. McKenna (Dictograph Products Corporation). February 7th, 1922. (197,028.)

3,523. "Sectional switchboard frame." T. McKenna (Dictograph Products Corporation). February 7th, 1922. (197,029.)

3,741. "Electrical plug contacts." D. Lodder and G. Verdonk, jun. February 9th, 1921. (175,280.)

3,857. "Vehicular head-lights, searchlights, and the like." Edison Swan Electric Co., Ltd., and C. E. Hiatt. February 9th, 1922. (197,040.)

3,926. "Changeable electric code switch." J. A. E. A. Ellis. February 10th, 1922. (197,046.)

4,179. "Electric time switches." J. Clifton, J. Robinson, and J. Spencer. February 13th, 1922. (197,052.)

4,351. "Telephone systems." D. C. Crowe. February 14th, 1922. (197,058.)

4,481. "Electro-deposition of metals." T. W. S. Hutchins. February 15th, 1922. (197,066.)

4,485. "Electric switches." Hart Manufacturing Co. February 24th, 1921. (175,972.)

4,582. "Lamp fittings for self-propelled vehicles." British Thomson-Houston Co., Ltd., and L. Griffiths. February 16th, 1922. (197,070.)

4,615. "Electrical resistance thermometers." A. W. Mathys (Wilson-Maeulen Co.). February 16th, 1922. (197,072.)

4,923. "Receiving apparatus for wireless and other tuned signalling." J. B. Bolitho. February 20th, 1922. (Cognate application 30,993/22.) (197,077.)

5,060. "Insulators for supporting electric conductors." R. J. Kaula and A. H. Railing. February 21st, 1922. (197,079.)

5,170. "Electrical instruments and the like." C. P. Ratcliffe and W. K. Barker and S. G. Jones. February 22nd, 1922. (197,084.)

5,351. "Electrically-heated tools." British Thomson-Houston Co., Ltd. (General Electric Co.). February 23rd, 1922. (197,087.)

5,399. "Fuses for use in electric wiring systems." F. C. B. Chase. February 23rd, 1922. (197,089.)

5,545. "Telephone exchange systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 24th, 1922. (197,093.)

5,579. "Head-lights or lamps for motor-cars and like vehicles." F. J. Smith. February 25th, 1922. (197,096.)

5,629. "Wireless telegraph and telephone systems." H. J. Warner and T. H. Kinman. February 25th, 1922. (197,098.)

6,072. "Thermostatic electric circuit controllers." British Thomson-Houston Co., Ltd. (General Electric Co.). March 1st, 1922. (197,106.)

6,330. "Cubicles or cells for enclosed electric switchgear." A. E. L. Scanes, E. E. I. Pilcher, and Metropolitan-Vickers Electrical Co., Ltd. March 3rd, 1922. (197,109.)

6,734. "Controllers for electrically-operated cranes, hoists, and the like." N. G. Langrish and Metropolitan-Vickers Electrical Co., Ltd. March 7th, 1922. (197,113.)

8,056. "Coil ignition systems for multi-cylinder internal-combustion engines." N. A. Block and J. W. Coward. March 20th, 1922. (197,134.)

8,462. "Inductances." A. Onwood. March 23rd, 1922. (197,140.)

8,507. "Electric clocks." L. H. M. Huydts. September 30th, 1921. (186,574.)

8,578. "Electric protective devices." C. J. Rixen. March 24th, 1922. (197,144.)

9,221. "Controlling means for motor-driven pumps." New British Electric Supply Co., Ltd., and H. C. E. Jacoby. March 30th, 1922. (197,153.)

9,363. "Electric induction furnaces." Vacuumschmelze Ges. and Dr. W. Rohn. March 31st, 1922. (197,155.)

9,532. "Mounting of pointers or needles in galvanometers and other instruments." British Thomson-Houston Co., Ltd. (General Electric Co.). April 3rd, 1922. (197,157.)

9,925. "Vents for electric storage batteries." Fuller's United Electric Works, Ltd., and R. E. Beswick. April 7th, 1922. (197,160.)

10,231. "Spark plugs." W. F. Hills, W. H. Chard, and O. S. Eastman. April 10th, 1922. (197,165.)

10,498. "Electric switches." J. B. Tucker. April 12th, 1922. (197,167.)

10,946. "Electrodes for electrolysis." R. F. Woodburn. April 19th, 1922. (197,170.)

10,987. "Electric switches." A. P. Lundberg, G. C. Lundberg, P. A. Lundberg, and G. Pegg. April 19th, 1922. (197,171.)

11,896. "Dry batteries." G. R. Baynton. April 28th, 1922. (197,183.)

12,088. "Selecting switches." Western Electric Co., Ltd. (Western Electric Co., Inc.). April 29th, 1922. (197,185.)

12,861. "Ignition magnetos for internal-combustion engines." H. Lucas and J. H. Chambers. May 6th, 1922. (197,190.)

13,422. "Welding electrodes." A. P. Strohmenger. May 12th, 1922. (197,196.)

14,059. "Electric accumulators or storage batteries." H. Leitner. May 18th, 1922. (197,204.)

14,908. "Electrical frequency meters." L. N. Reddie (Officine Meccaniche Italiane). May 26th, 1922. (197,209.)

15,769. "Electrical contact makers for use with the steering wheels of motor and other vehicles." L. A. A. Mignot. June 11th, 1921. (181,359.)

19,729. "Warning-signal for use with ships' telegraphs." T. W. Mair. July 18th, 1922. (197,238.)

21,841. "Charging device for miners' electric lamps." Concordia Elektrizitäts Akt. Ges. September 29th, 1921. (186,380.)

22,079. "Means for testing the ignition systems of internal-combustion engines." C. E. Goodrum and C. Haines. August 14th, 1922. (197,243.)

25,078. "Apparatus for automatically operating electric switches of electrically-driven pumps." E. W. Buckley and Mather & Platt, Ltd. September 16th, 1922. (197,253.)

29,067. "Device for enabling ignition and like coils and sparking plugs to be tested and adjusted." R. W. Sanders. October 25th, 1922. (197,265.)

35,344. "Overhead supply systems for electric traction." O. Kurz. March 7th, 1921. (Divided application on 176,709.) (191,069.)

1923.

5,361. "Loop antennæ." Marconi's Wireless Telegraph Co., Ltd. March 14th, 1922. (195,051.)

The Russian Electrical Industry.—No sooner was the All-Russian Share Co. to Finance Local Electrification (the Elektrocredit) formed, than applications arrived from all quarters for facilities to electrify, but generally the estimates of costs proved to be too high for the interested establishments to enter into engagements. Thus, for want of customers there are abnormal stocks at the factories. At the moment, says a Russian journal, the electrical trusts have 2,000,000 pre-war roubles' value of machines of 200 kW capacity or less; 400,000 roubles' value in installation equipment; and 2,000,000 roubles' value in insulated wire. The question remains one of finance to enable work to be done and reduce the stocks at factories, so that these may obtain funds to carry on.